



Linking fish productivity to deep-sea coral and sponges in Alaska

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December 10, 2014

**NOAA
FISHERIES
SERVICE**

Overall questions:

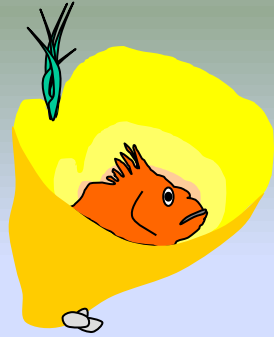
Are there more rockfish where coral and sponge are present?

Does coral or sponge presence increase rockfish growth or condition?

How much fishery production do we lose with every kg of invertebrates removed?



Studies



Aleutian Juvenile POP study 2003, 2004, 2007, 2008

Zhemchug Ridges study 2008

Snakehead Bank study 2009

Modeling-habitat studies 2003-2012

FMP – Production study 2012-2014



*Eastern
Bering Sea*

Aleutian Islands

Gulf of Alaska

Nanaimo

★ *Seattle*

Google

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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© 2010 Tele Atlas
58°18'25.91" N 154°40'48.95" W elev 442 ft

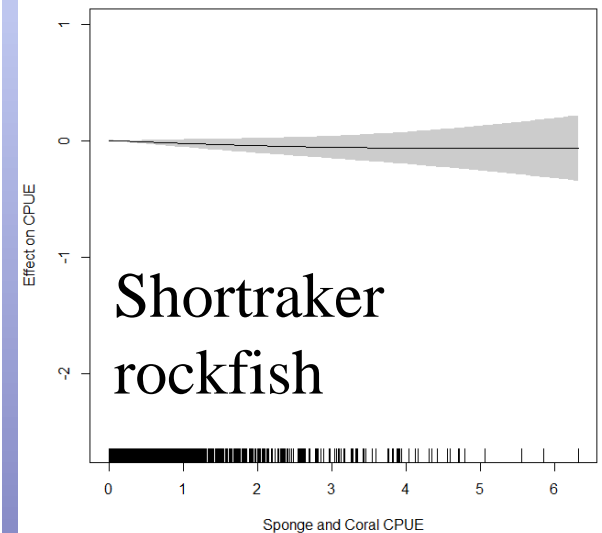
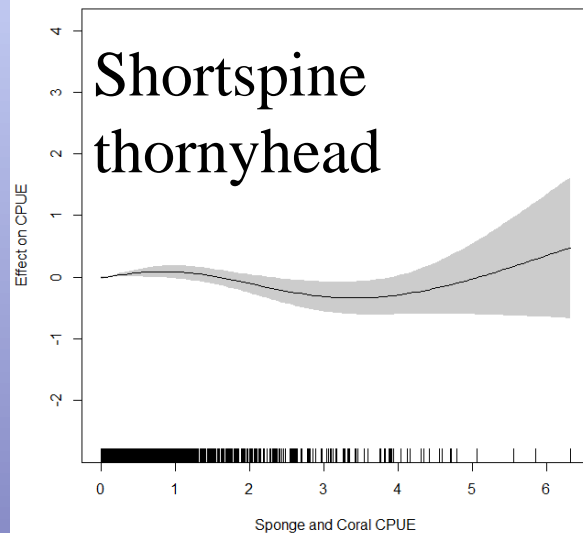
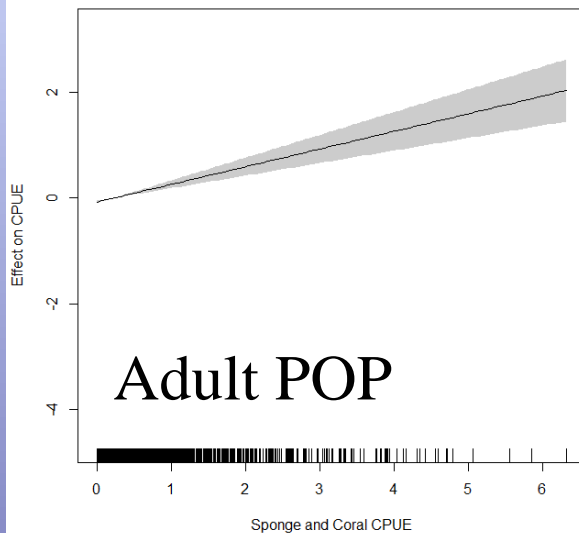
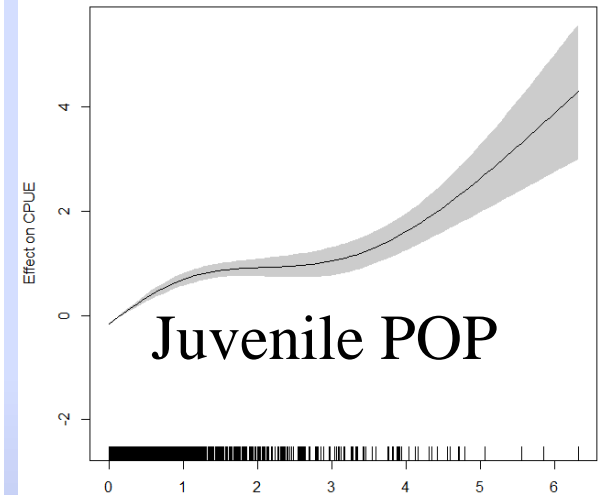
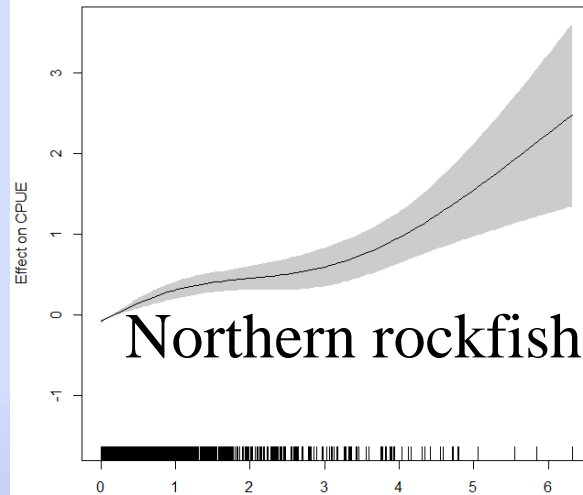
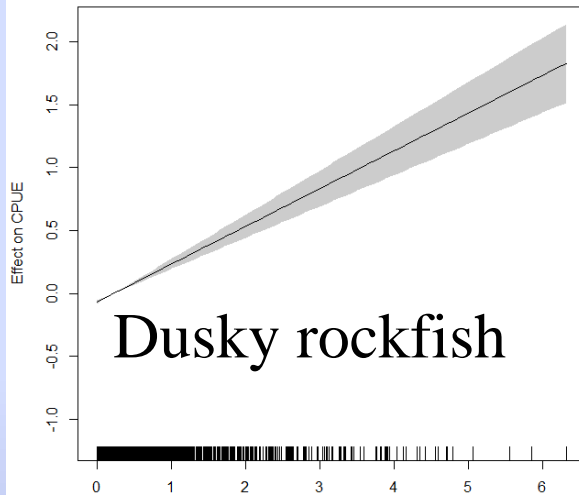
©2009

Eye alt 2576.23 m



Trawl survey data (Gulf of Alaska)

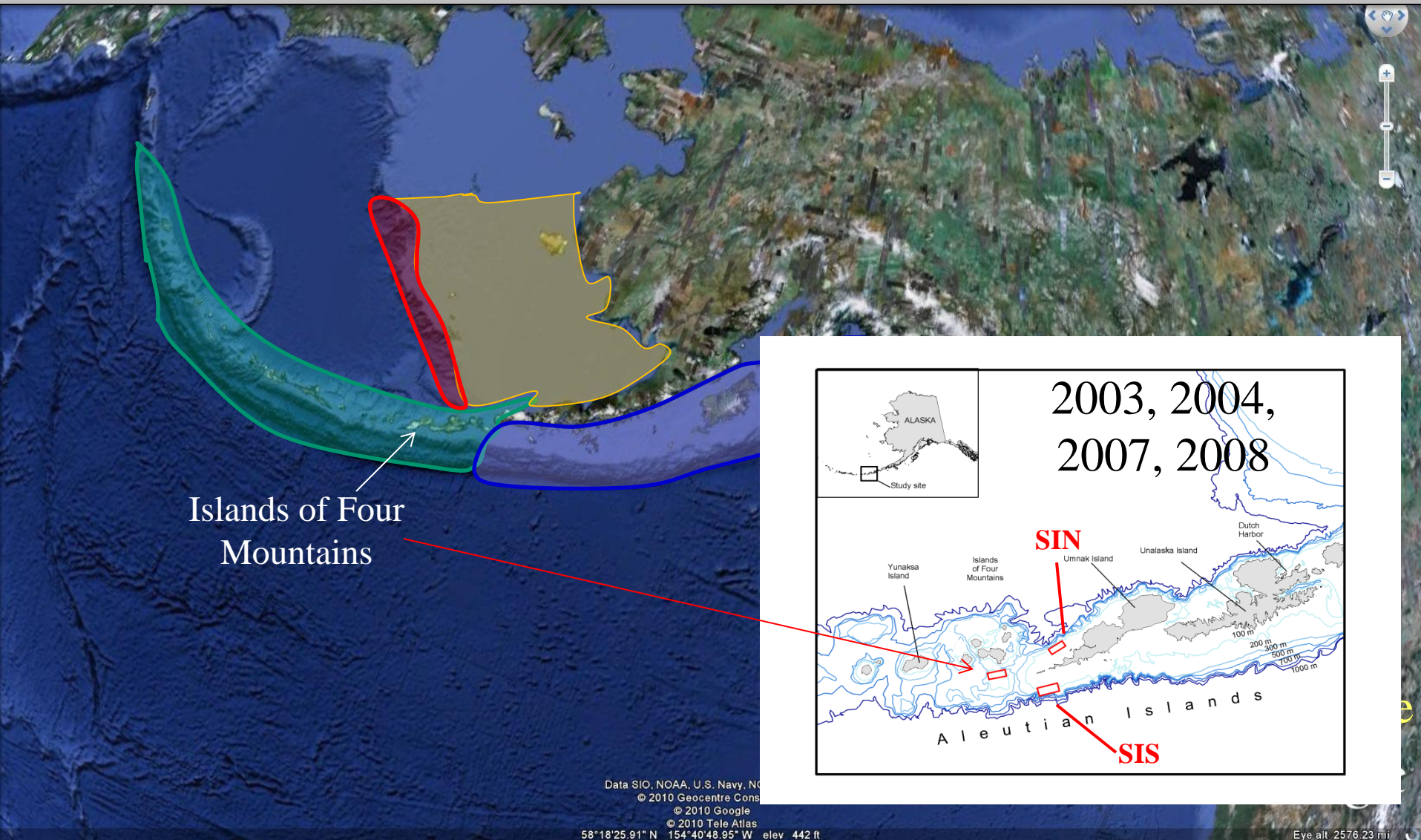
$CPUE = s(\text{location}) + s(\text{depth}) + s(\text{slope}) + s(\text{coral/sponge})$



Other Analyses on Alaska trawl survey data

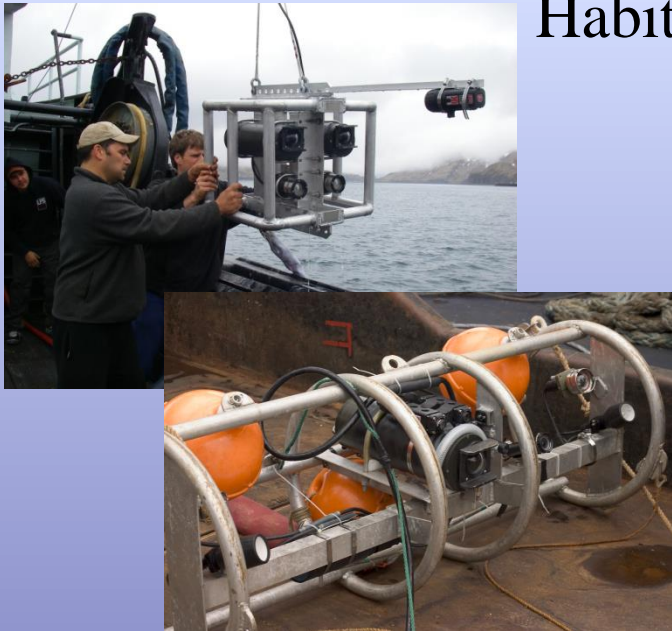
- Aleutian Islands
 - Multiple species (Heifetz et al. 2002, Malecha et al. 2005)
 - Juvenile POP (Rooper and Boldt 2005, Laman et al. in review)
 - Adult POP (Laman et al. in review)
- Gulf of Alaska
 - Multiple species (Rooper and Martin 2012, Krieger and Wing 2002, Malecha et al. 2005)
 - Shortspine thornyhead (Rooper et al. 2010)
- Eastern Bering Sea
 - (Malecha et al. 2005, Sigler et al. in review)

Juvenile POP study - Aleutians



Nursery Habitat Study

Collected data: Sidescan and multibeam sonar maps
Temperature
Zooplankton abundance
Juvenile Pacific ocean perch
Abundance
Diet
Energetics
Habitat use



Bedrock with sponge and coral



Bare sand



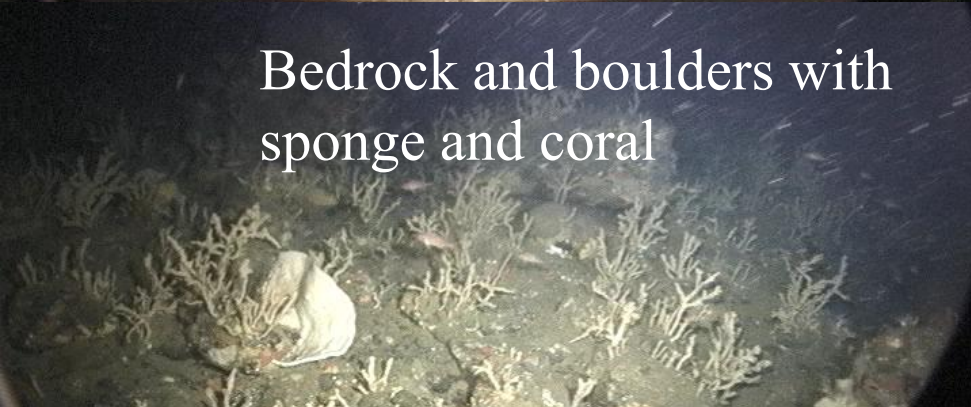
Bare sand with boulders/cobble



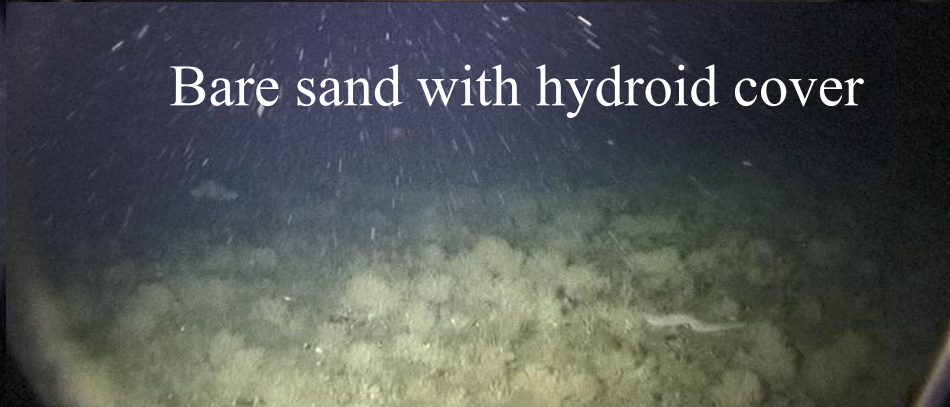
Bare sand with sea whips



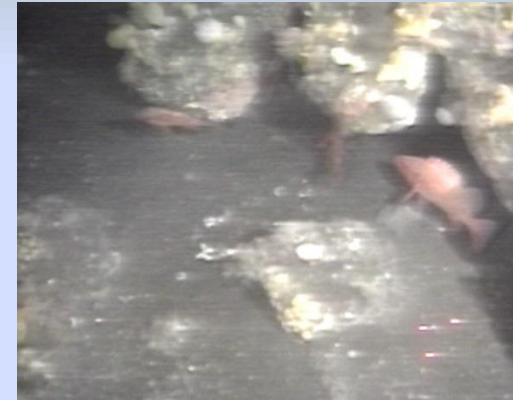
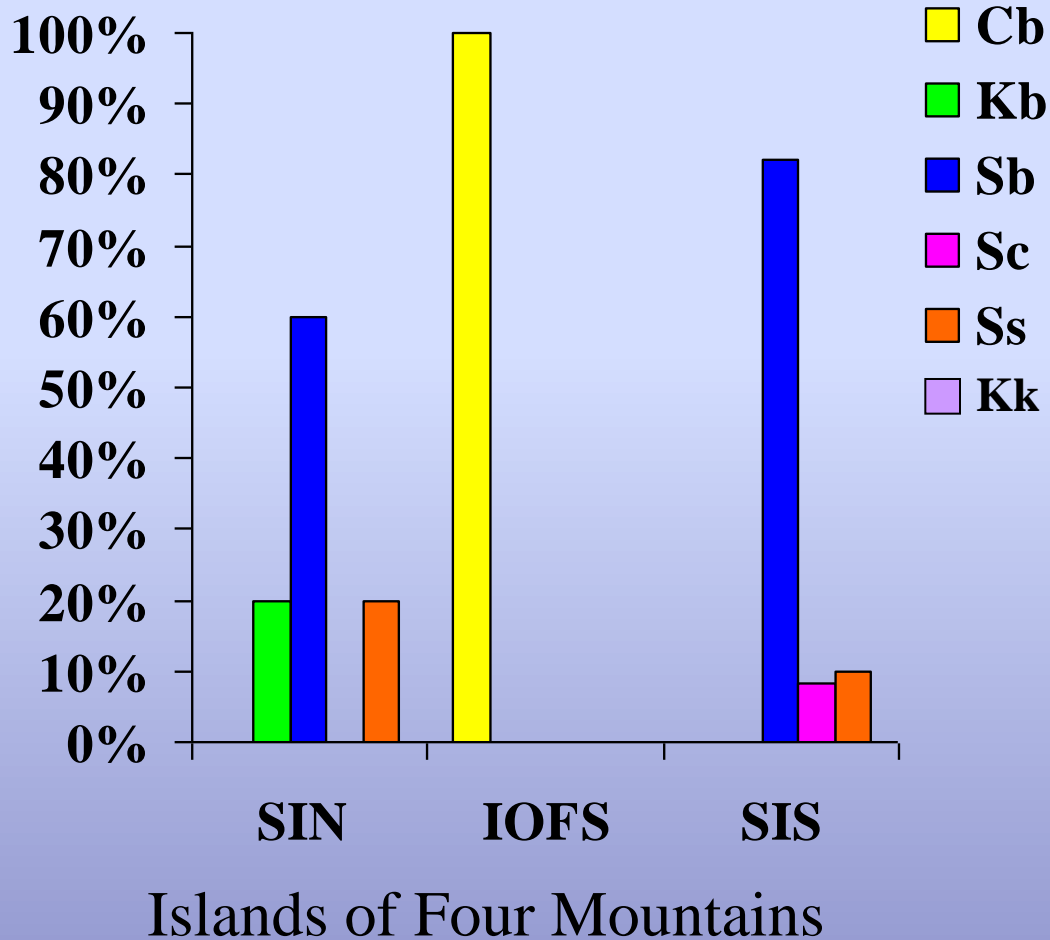
Bedrock and boulders with sponge and coral



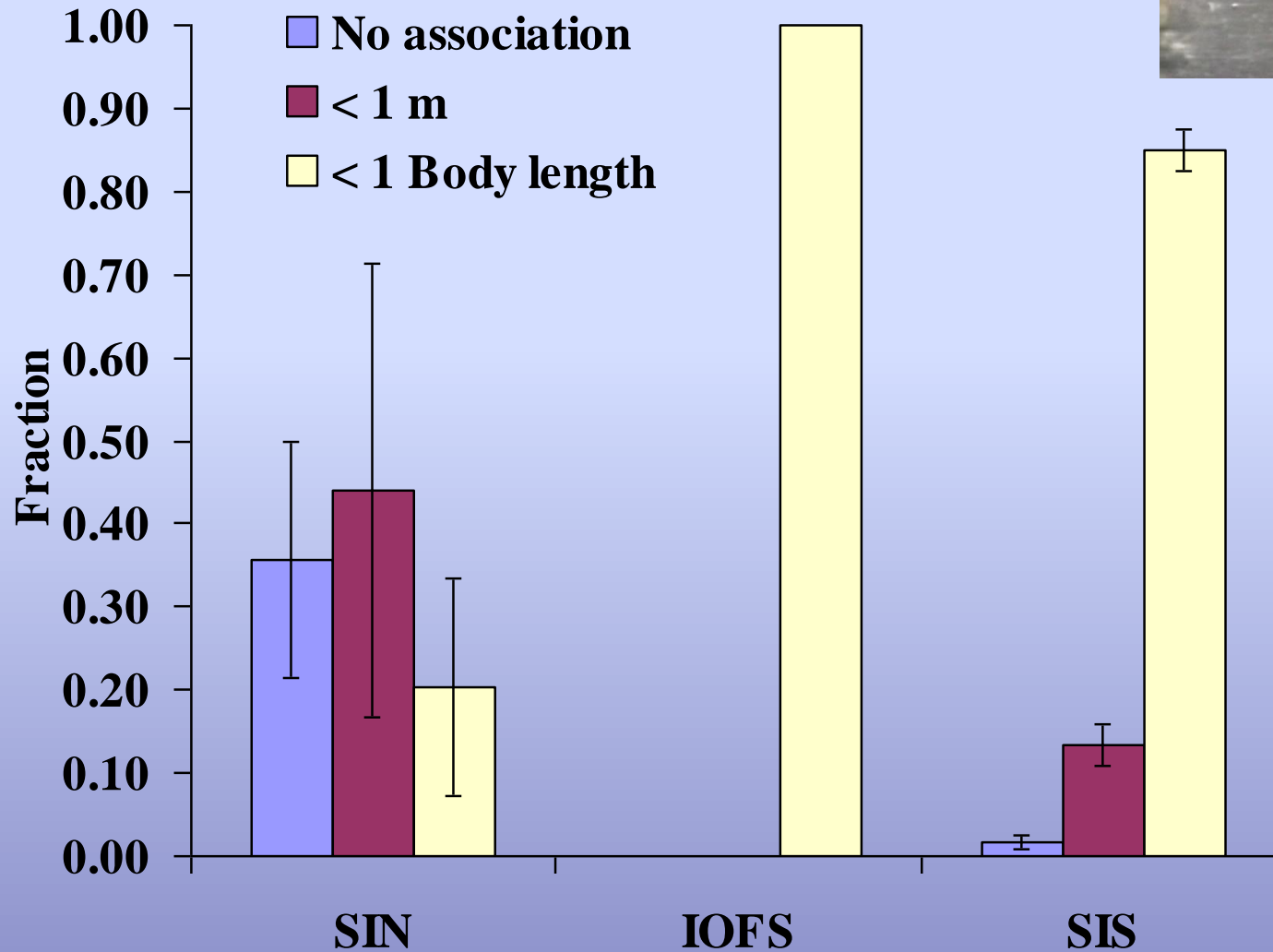
Bare sand with hydroid cover



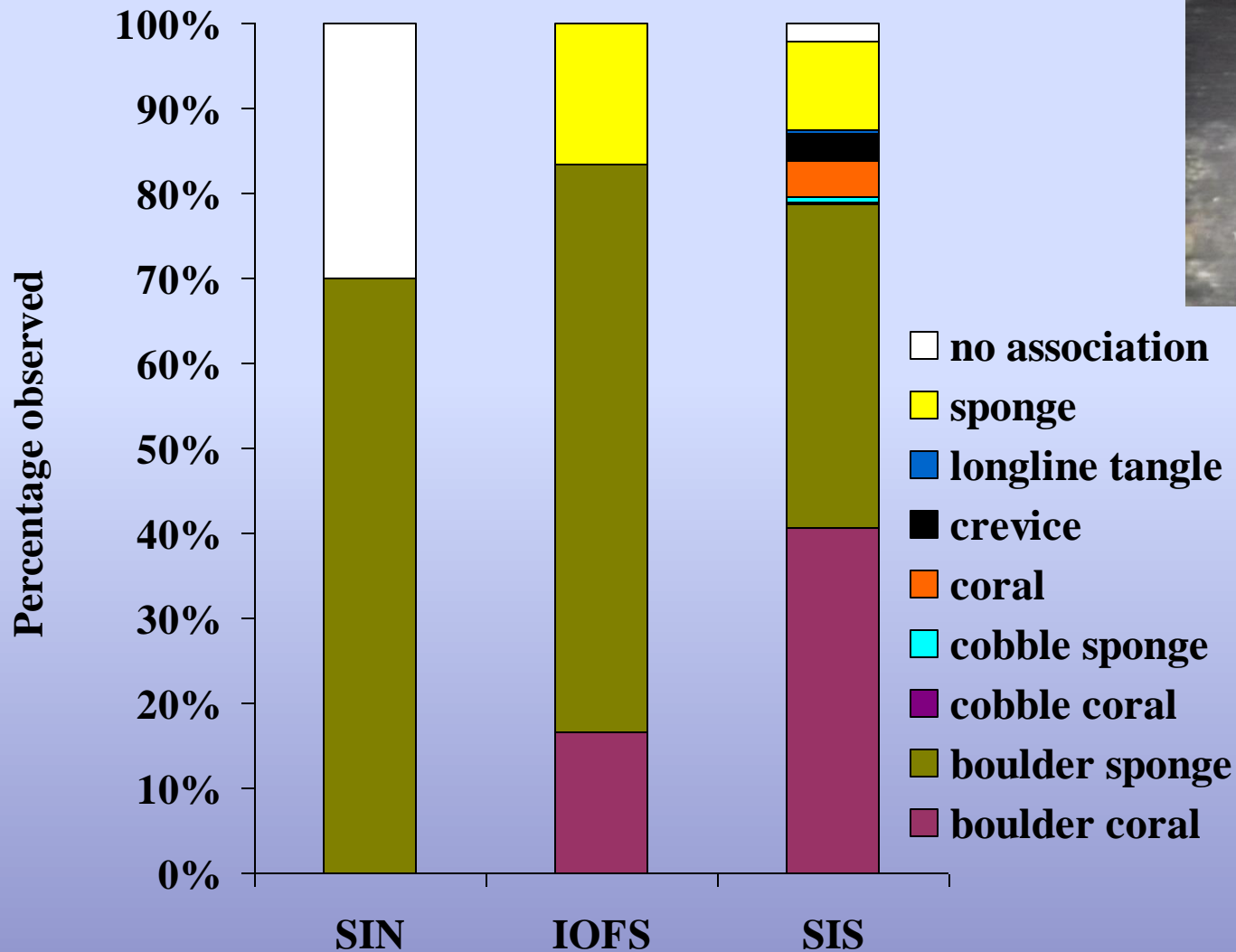
Juvenile POP observed by substrate type



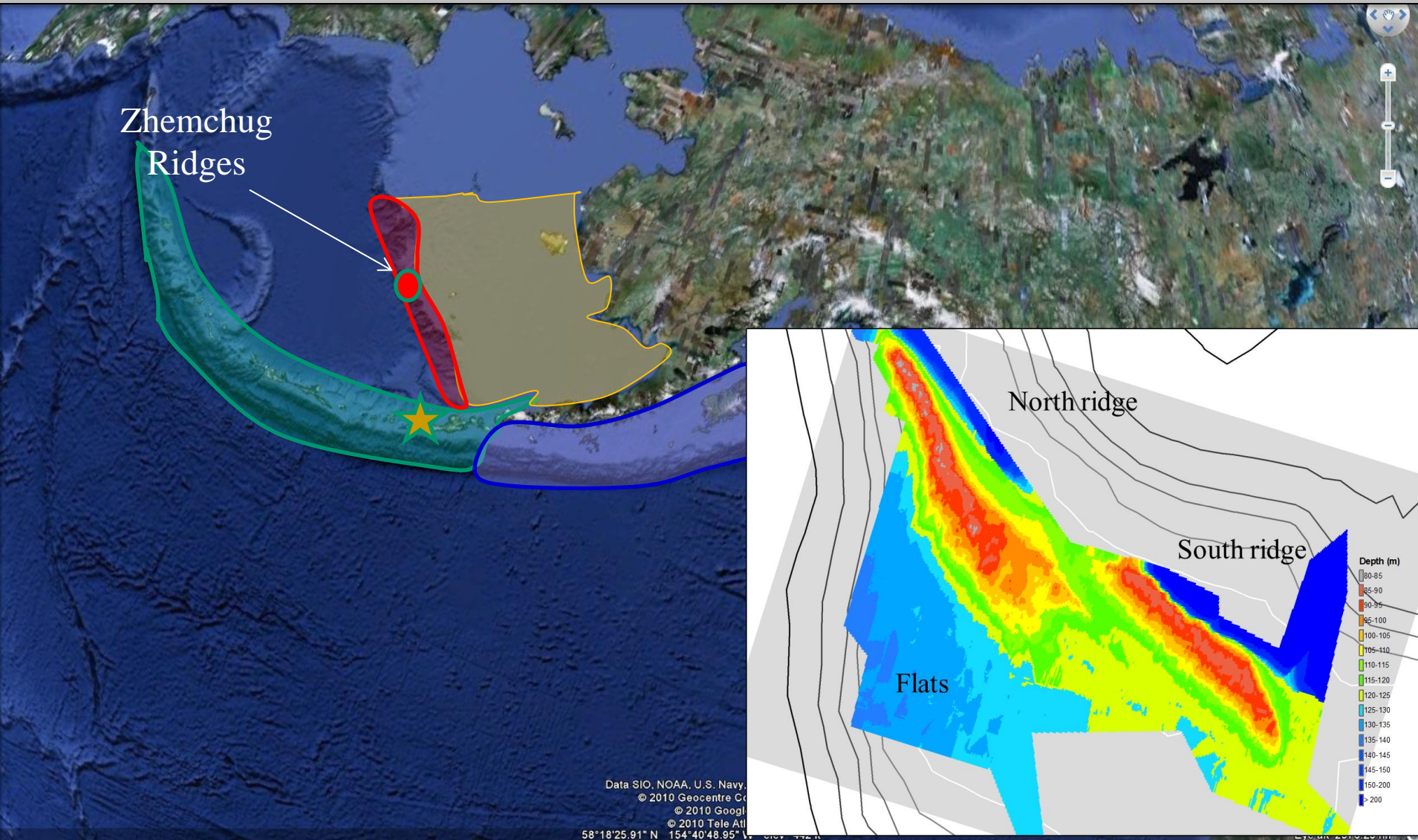
Association with structure

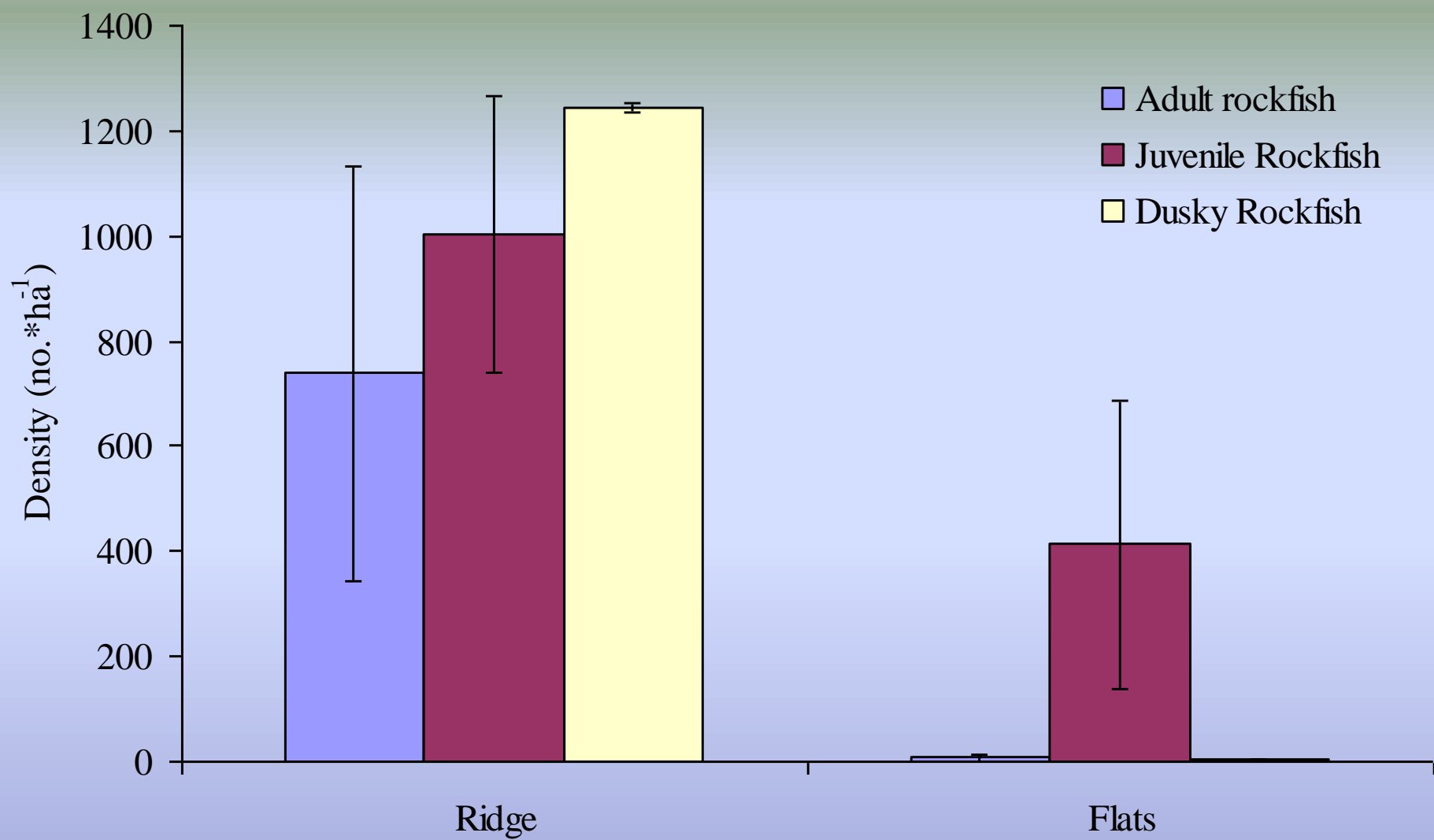


POP association by structure type

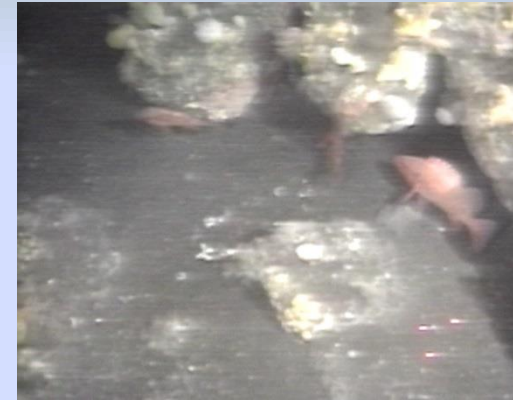
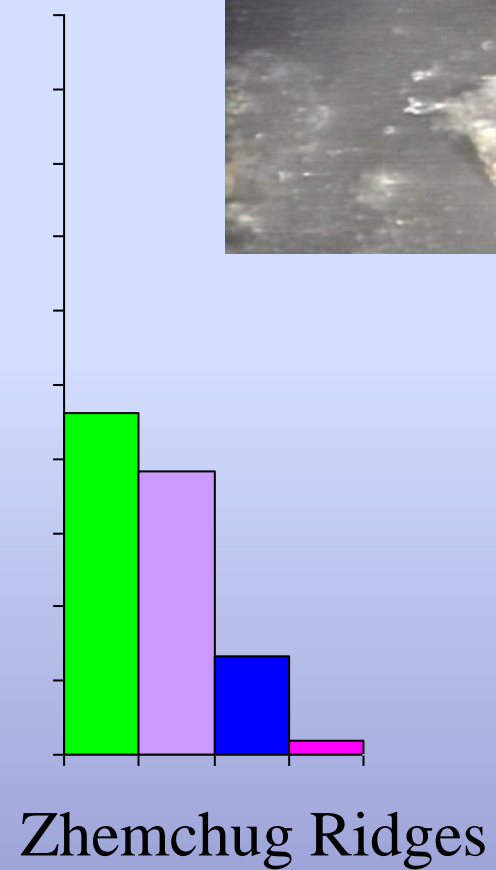
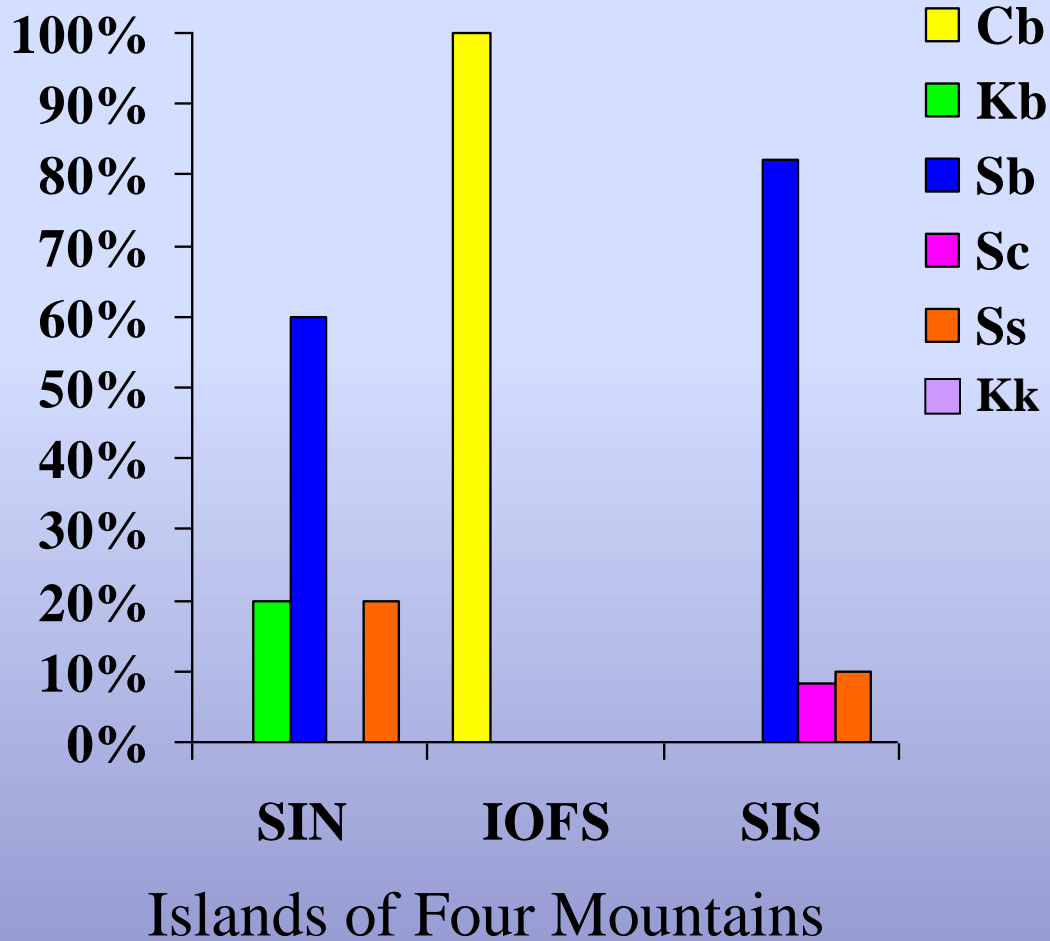


Acoustic Assessment – Zhemchug Ridges

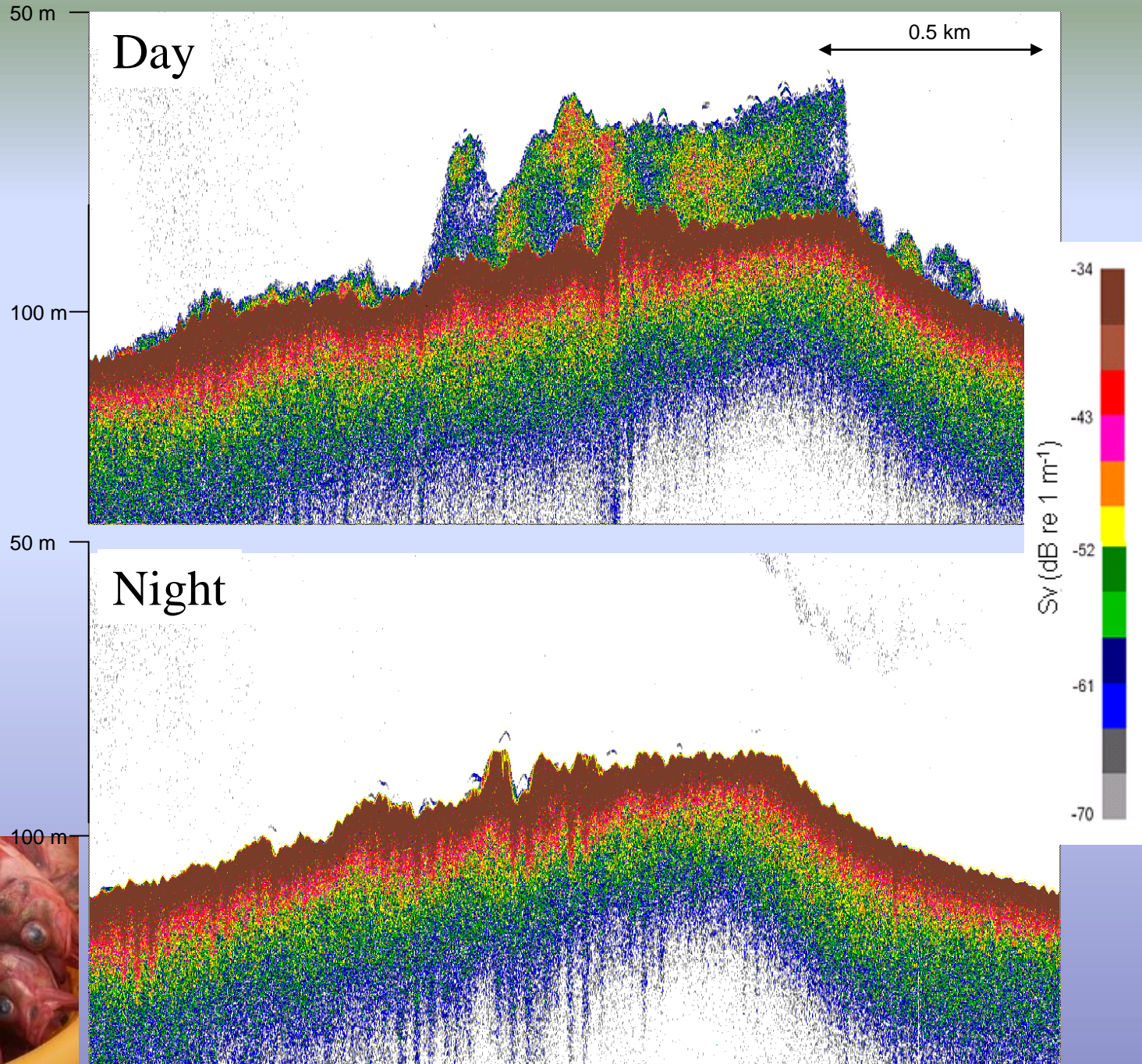




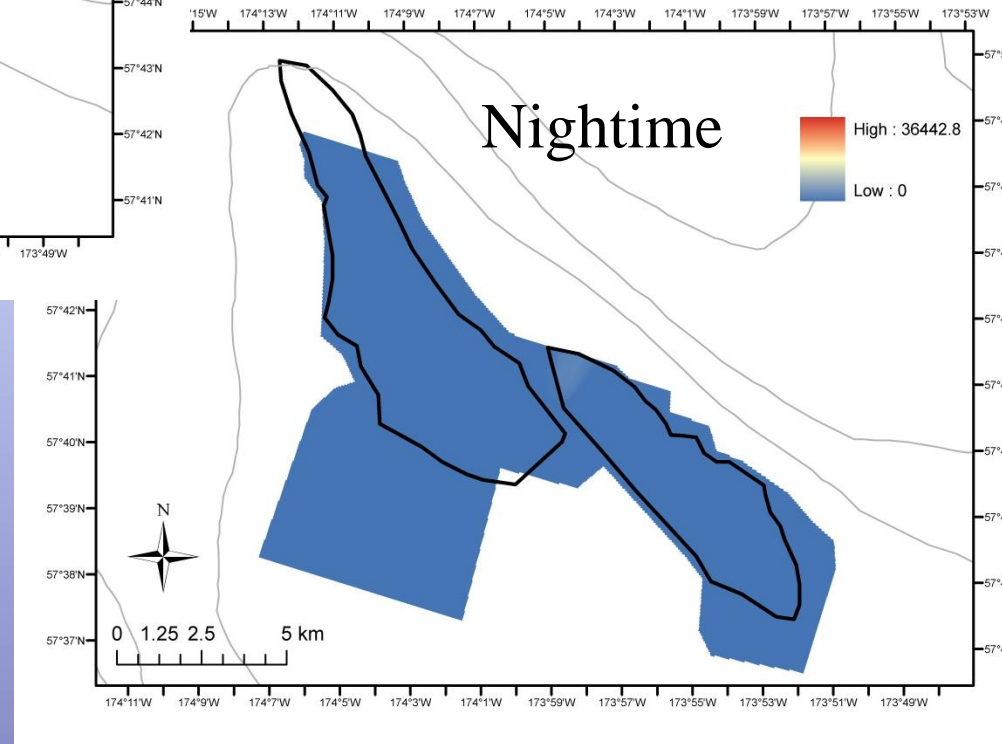
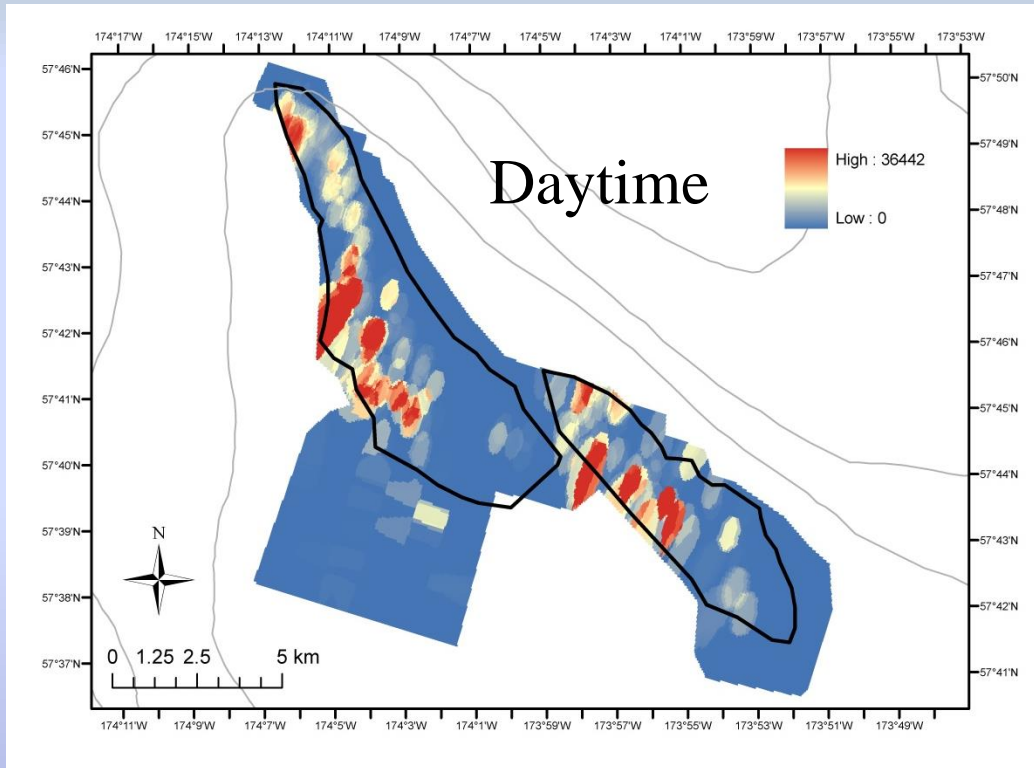
Juvenile POP observed by substrate type



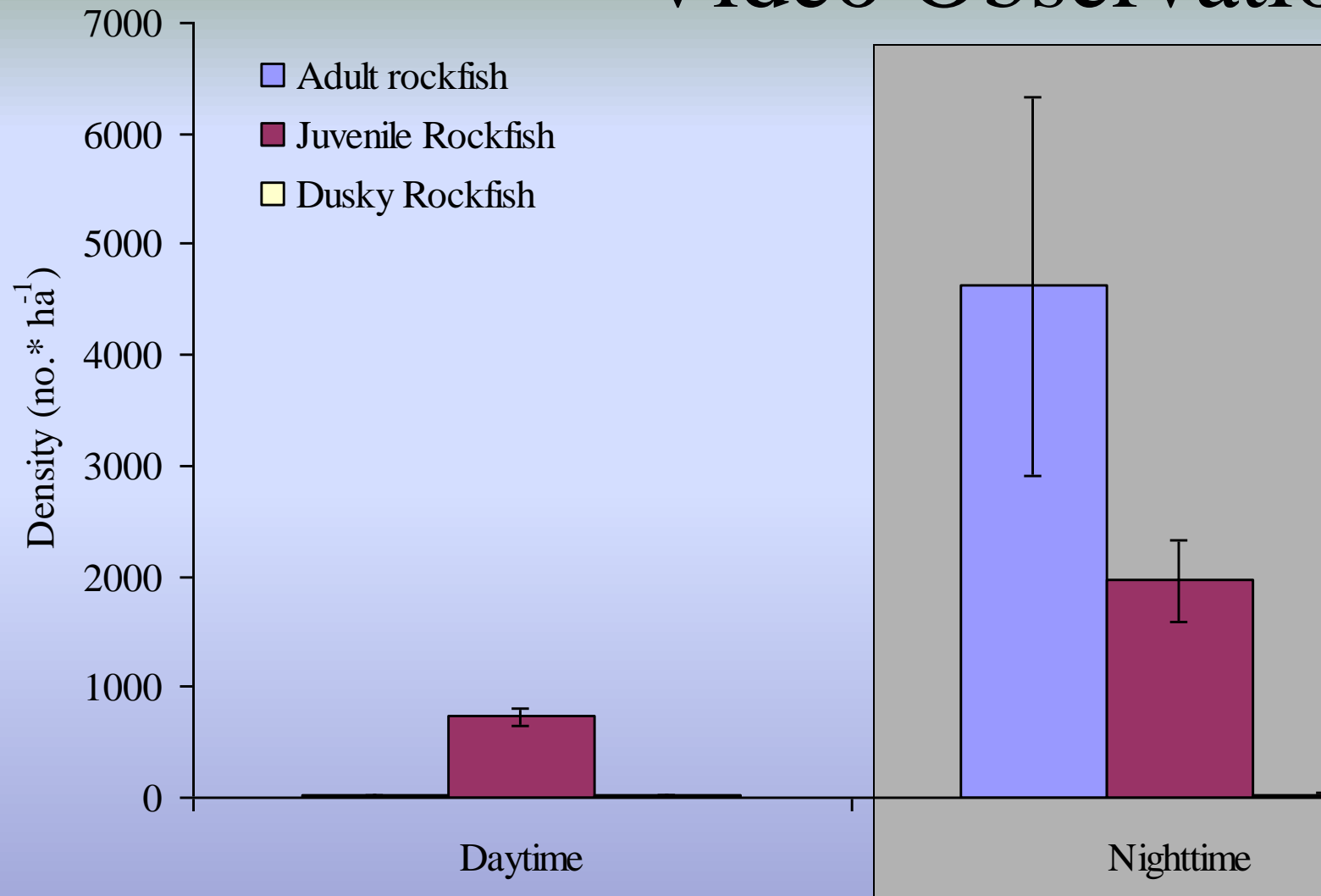
Acoustic Data



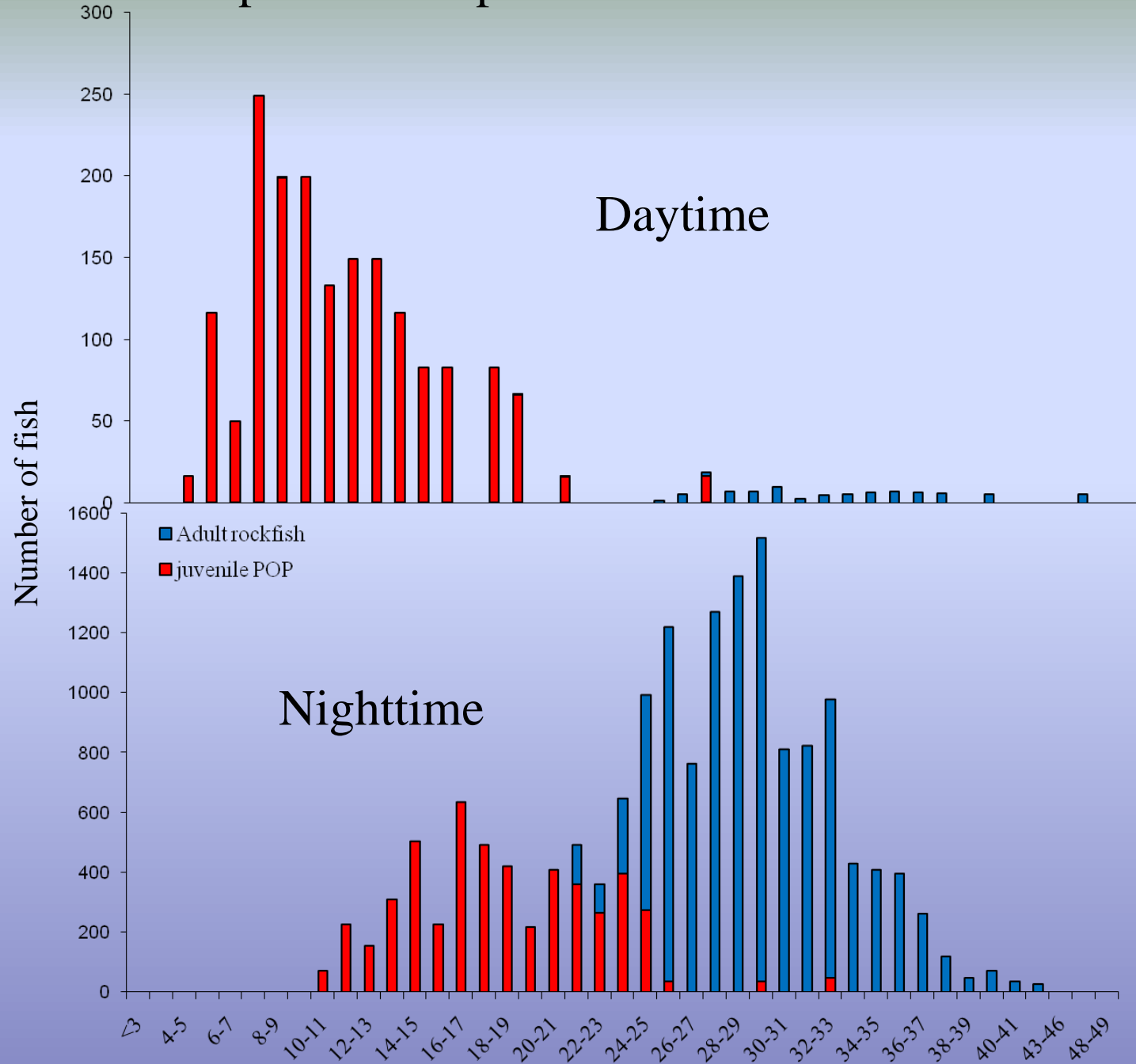
Water column Sv



Video Observations



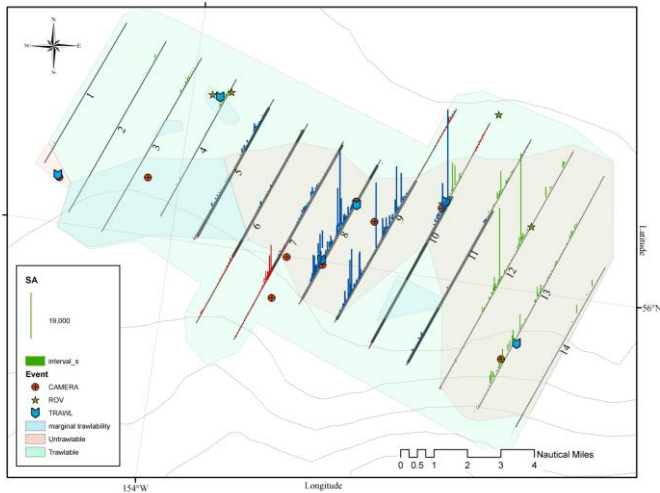
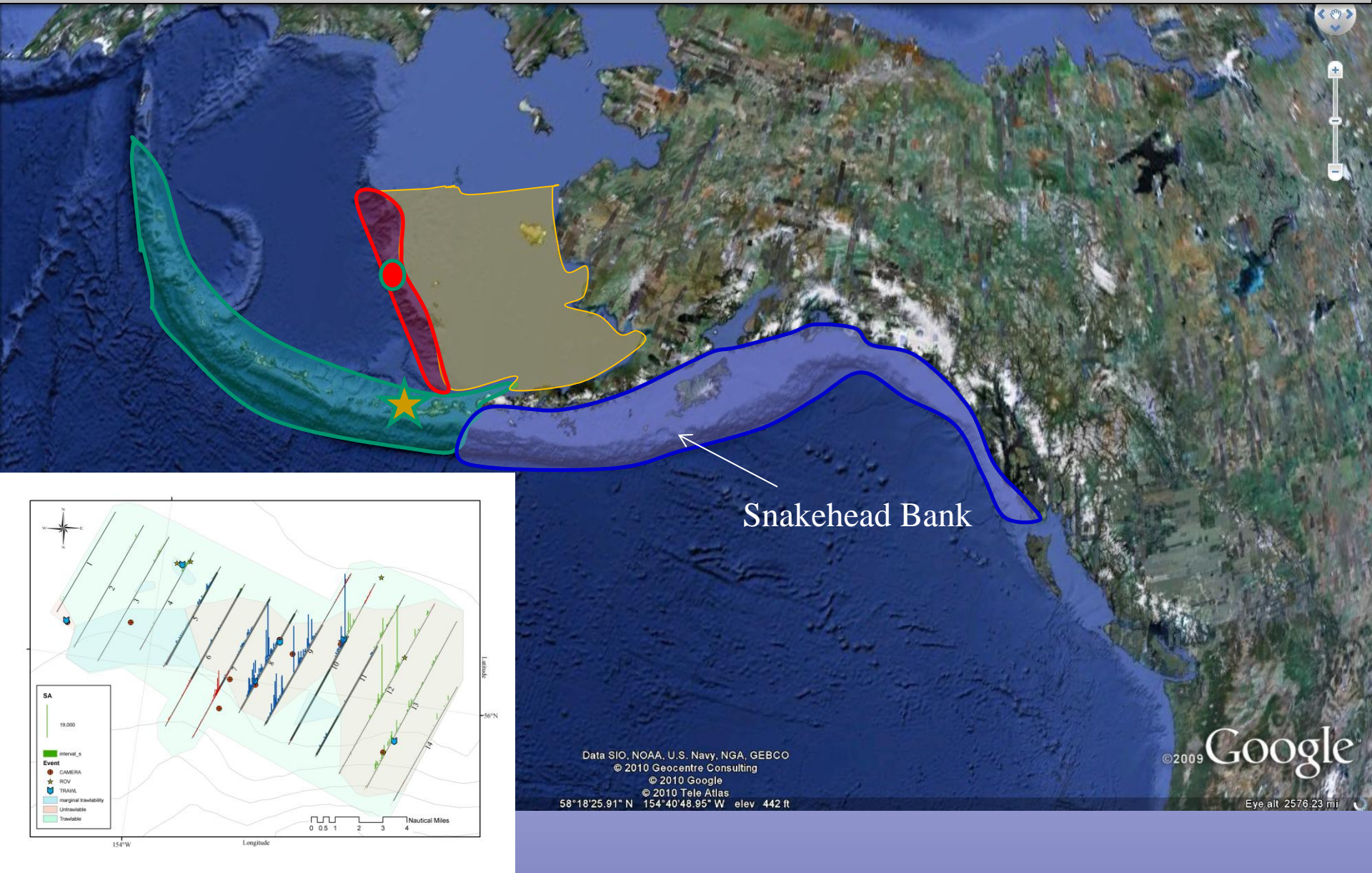
Size and Species Composition of Rockfish on the Seafloor



Zhemchug Ridges – 2014



Acoustic Assessment – Snakehead Bank



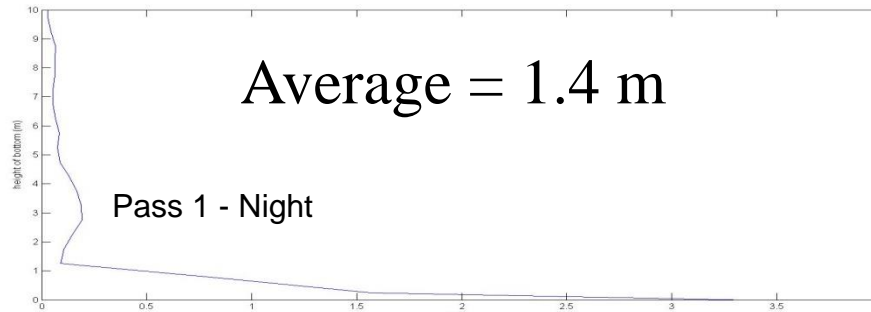


Snakehead Bank habitats

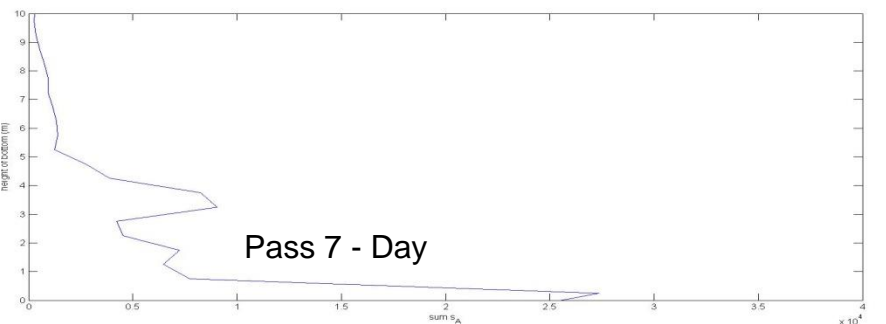
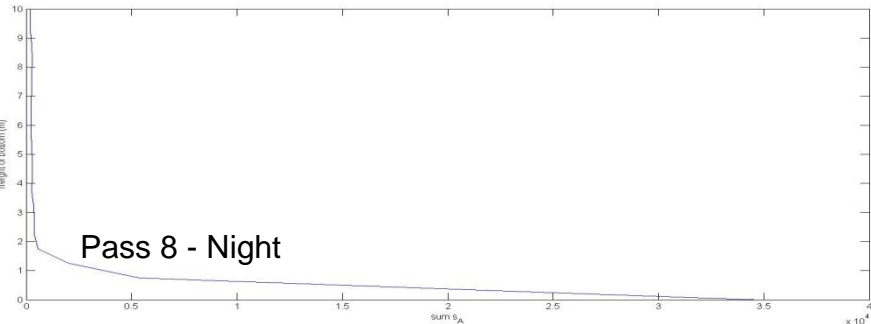
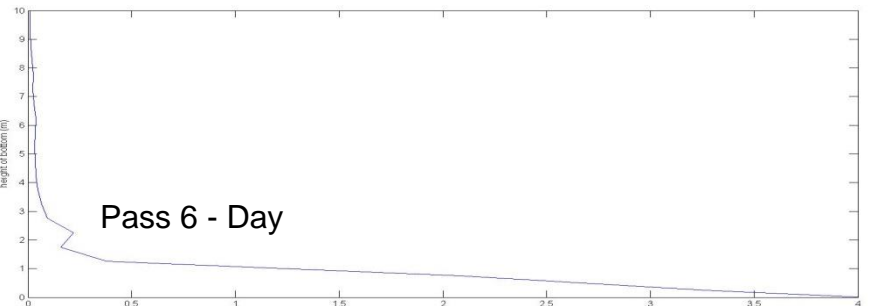
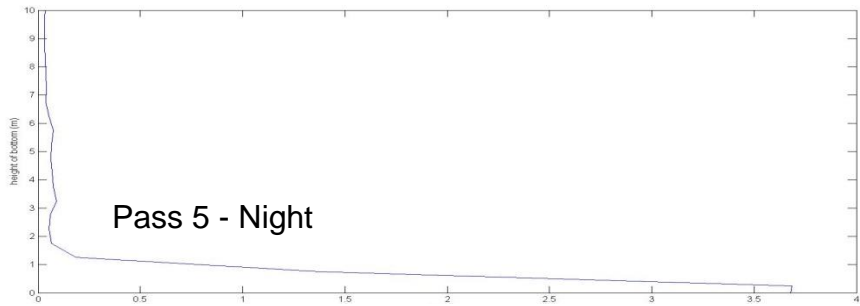
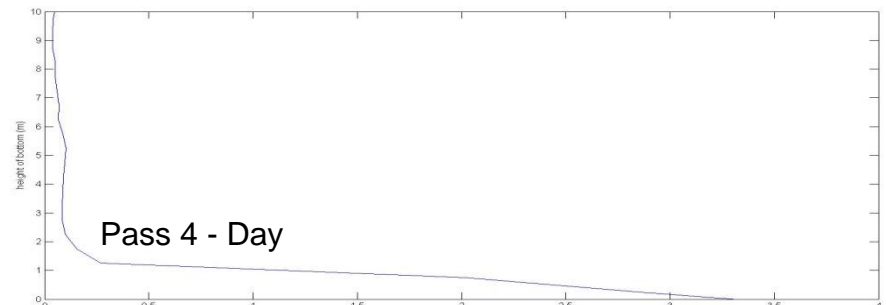
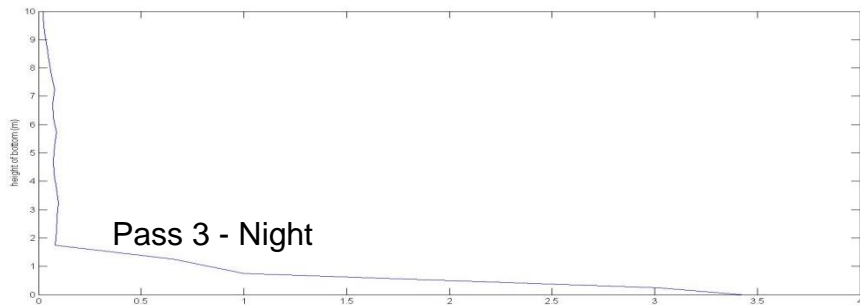
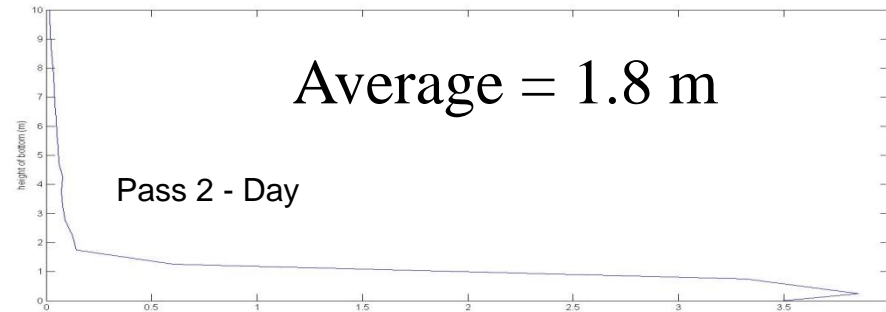


Rockfish SA height off bottom (to 10m) by pass

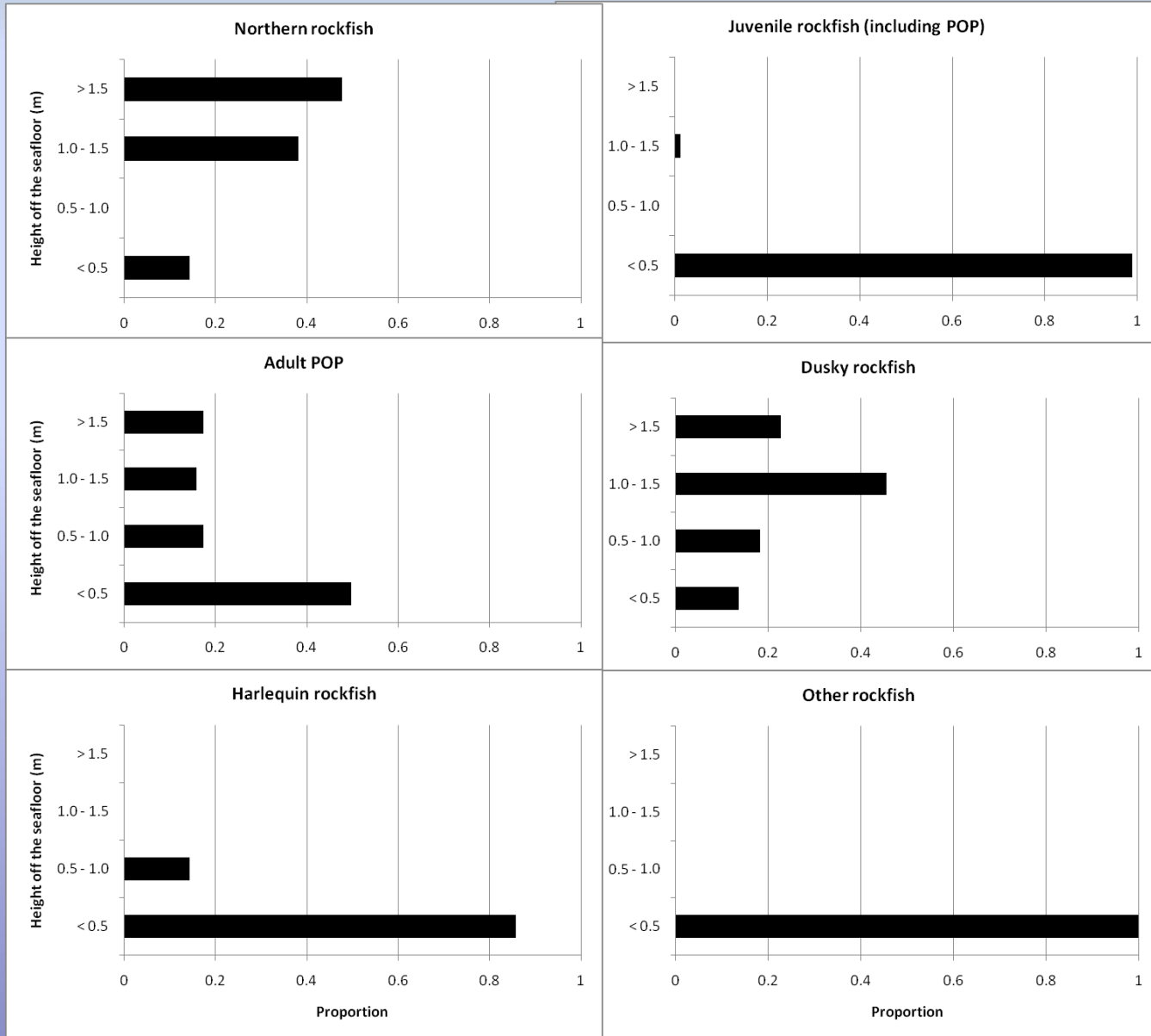
Average = 1.4 m



Average = 1.8 m

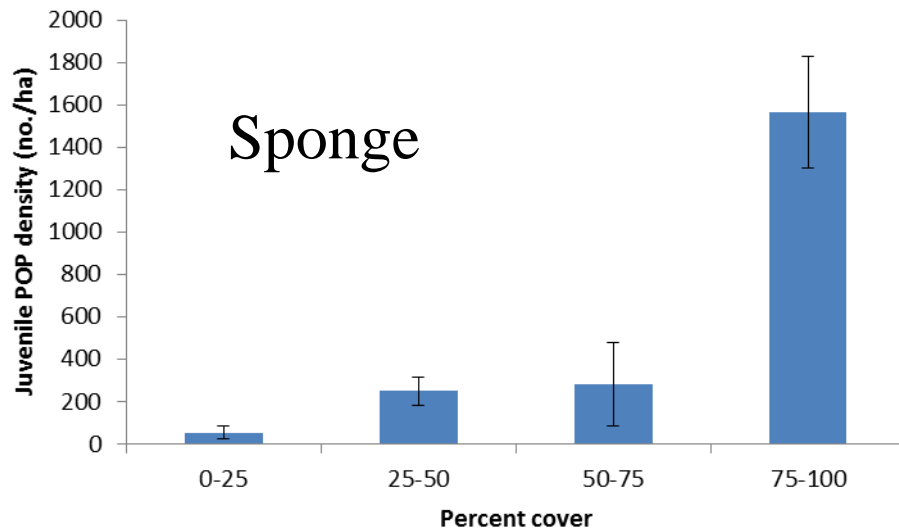


Height off bottom – Observed in imagery

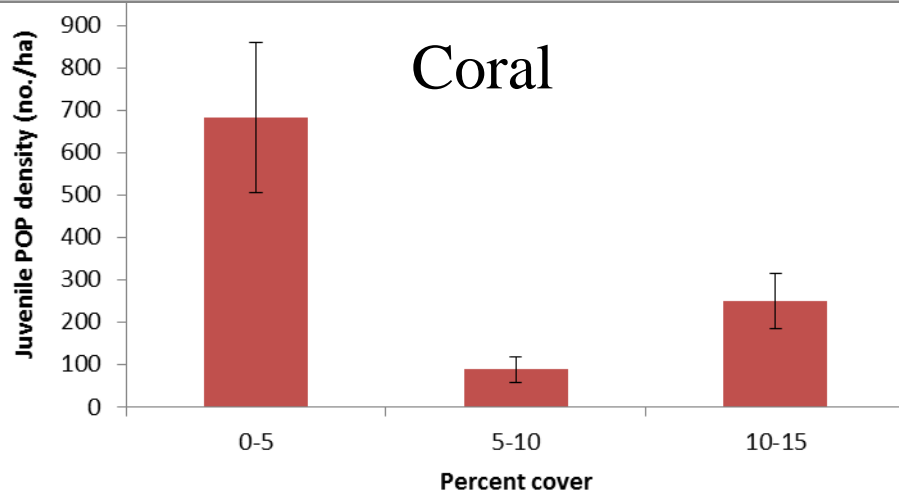


All camera studies lumped together
Same types of habitats

Sponge

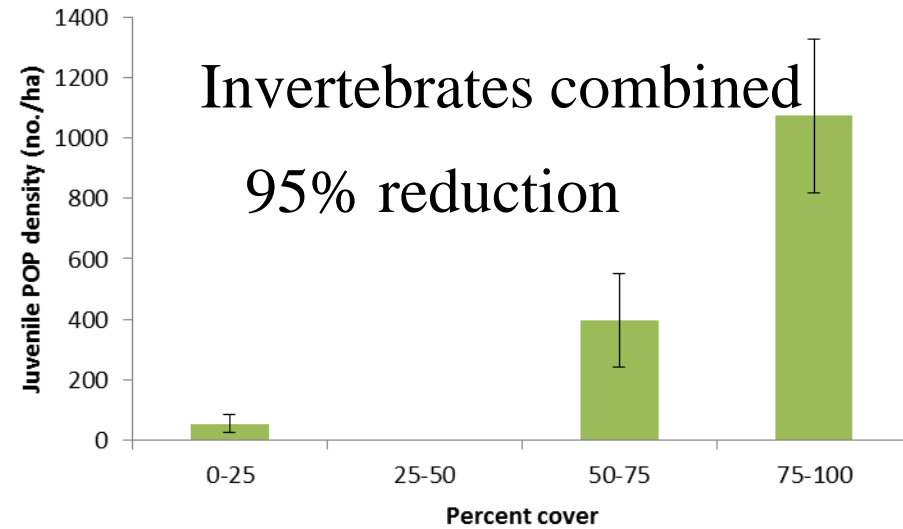


Coral

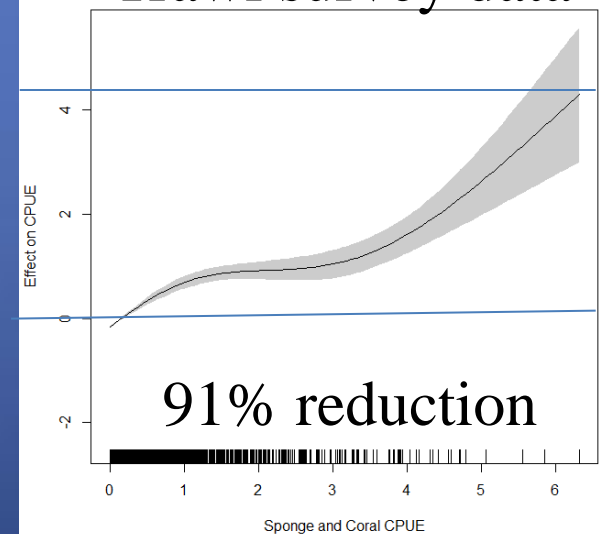


Invertebrates combined

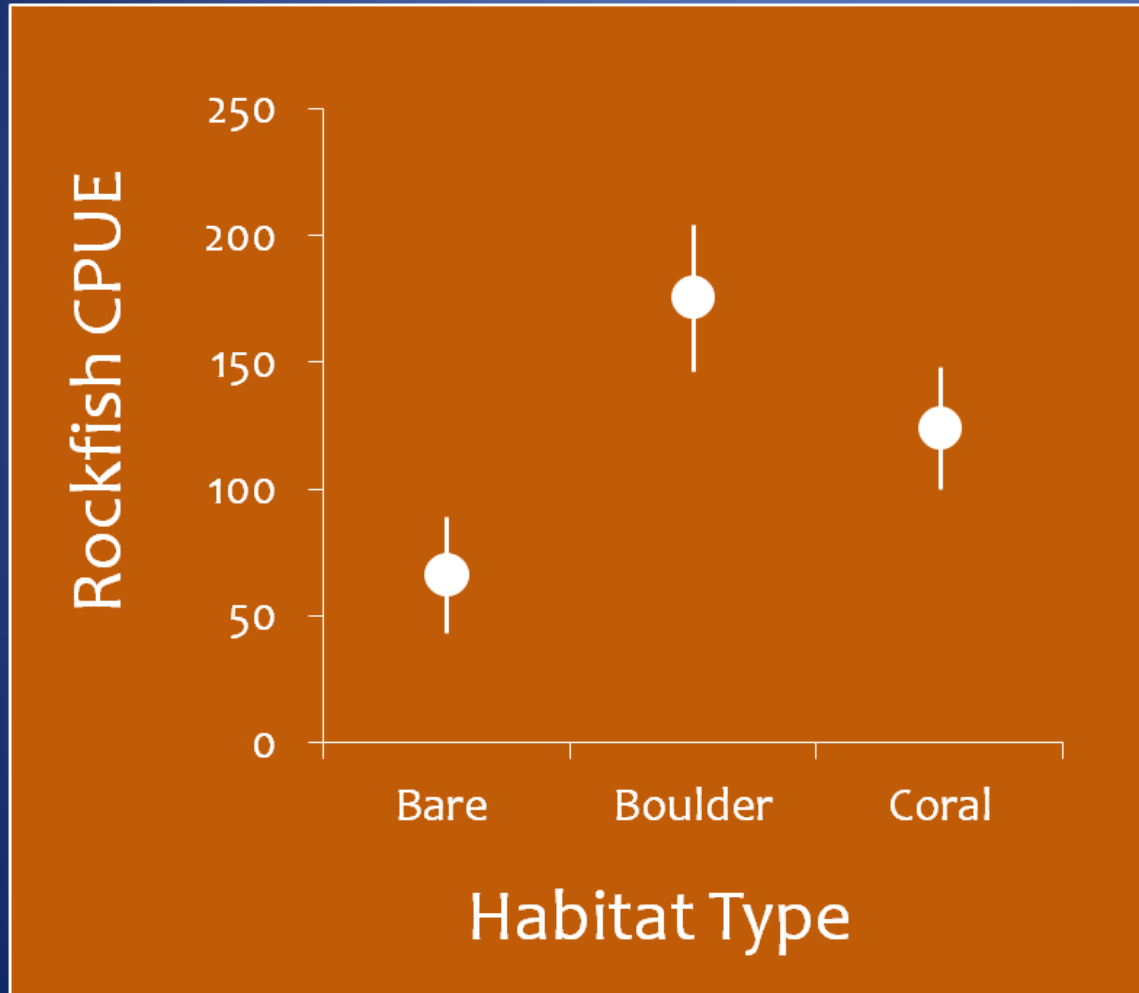
95% reduction



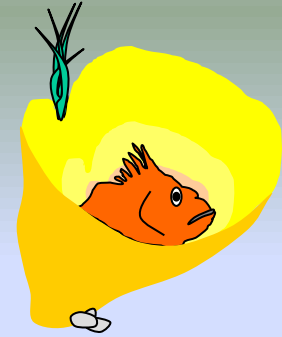
Trawl survey data



Adult rockfish – DSCRTP Alaska Study Central GOA



Are there more rockfish where sponge and coral are present?



Yes – For most shelf and shelf break species*

- Trawl survey data
- Underwater image data

***Association differs with species**

- Schooling semi-pelagic adults (POP, Northern RF, Dusky RF)
 - Juveniles and small RF (POP, Harlequin, Sharpchin)
 - Large Demersals (Yelloweye RF, Roughey RF, Blackspotted RF)
 - No association (Shortspine thornyhead, Shortraker RF)
- **Overall suggests (given the same substrate type) more coral = more juvenile POP**

Overall questions:

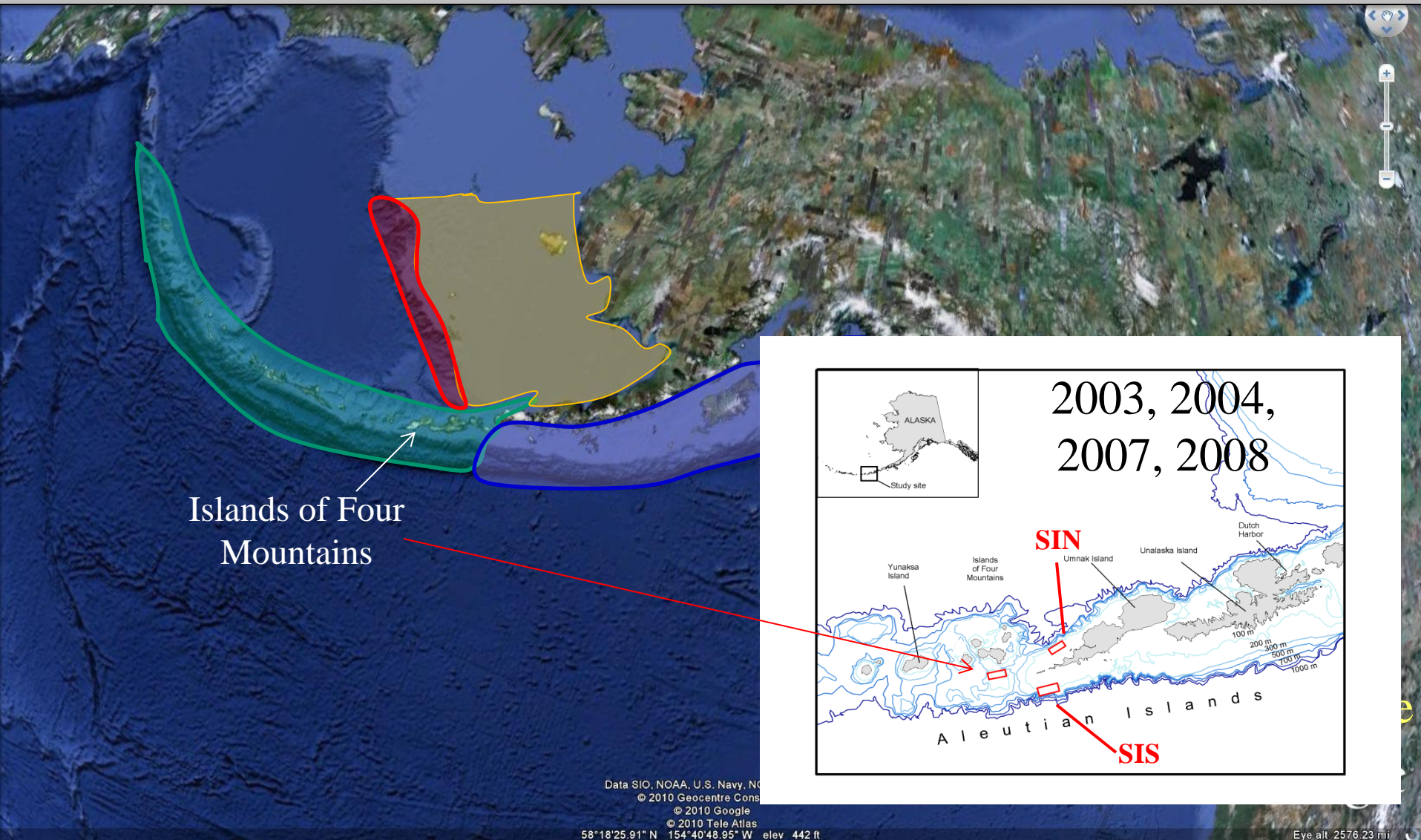
Are there more rockfish where coral and sponge are present?

Does coral or sponge presence increase rockfish growth or condition?

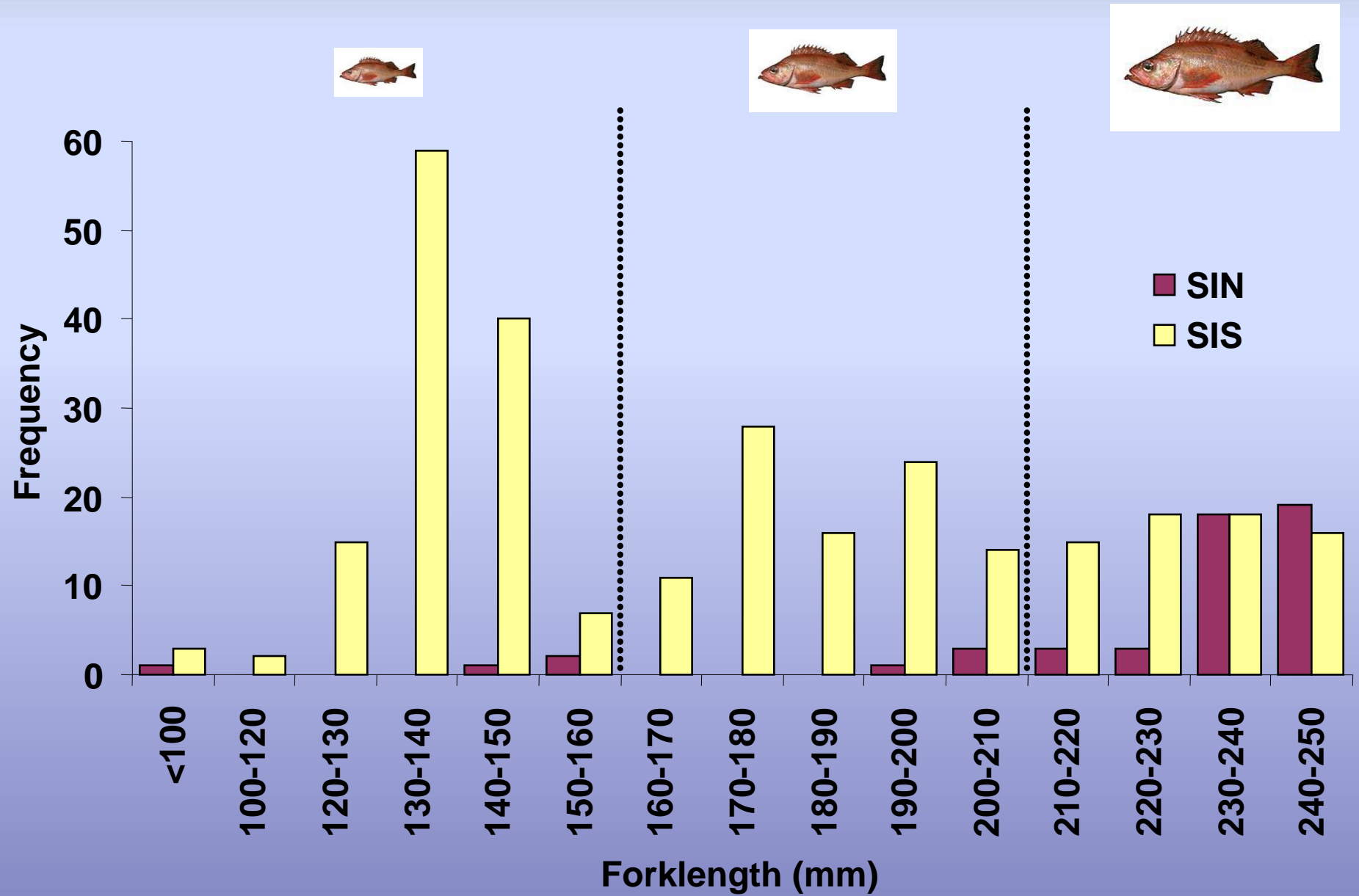
How much fishery production do we lose with every kg of invertebrates removed?



Juvenile POP study - Aleutians

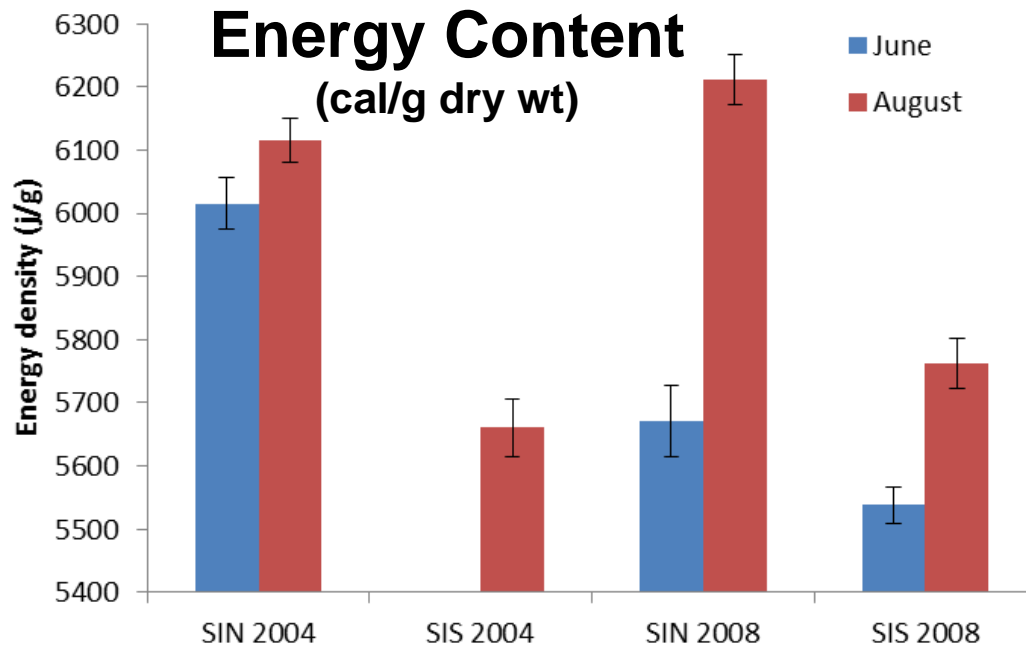
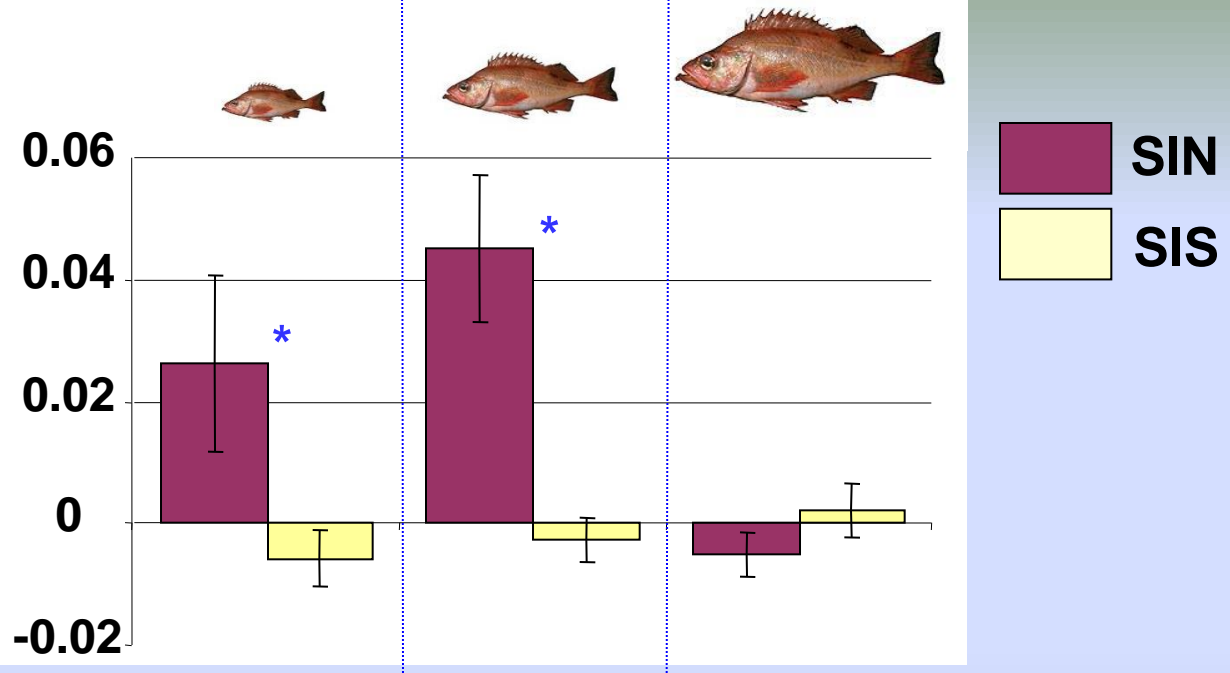


Size classes

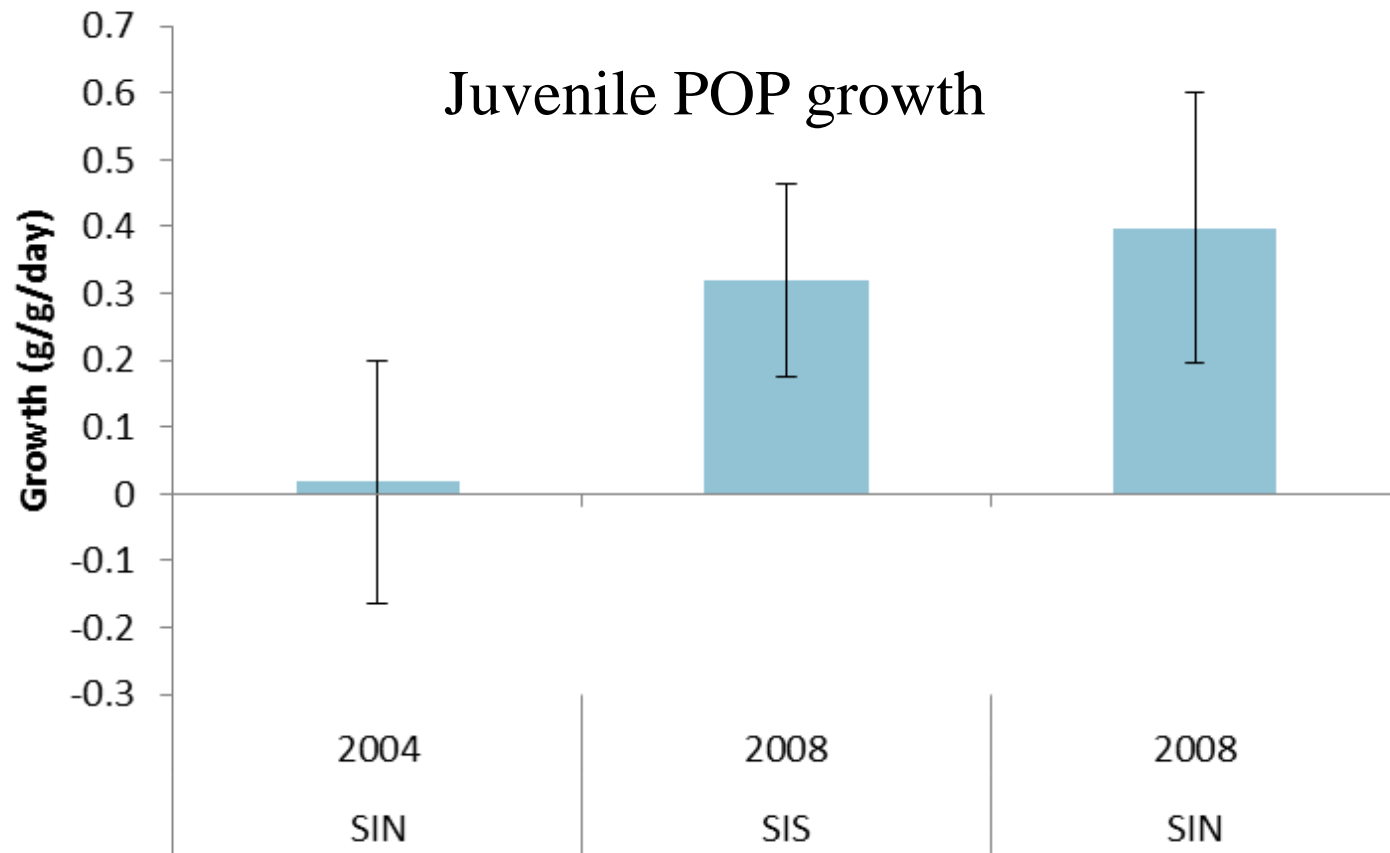


Condition

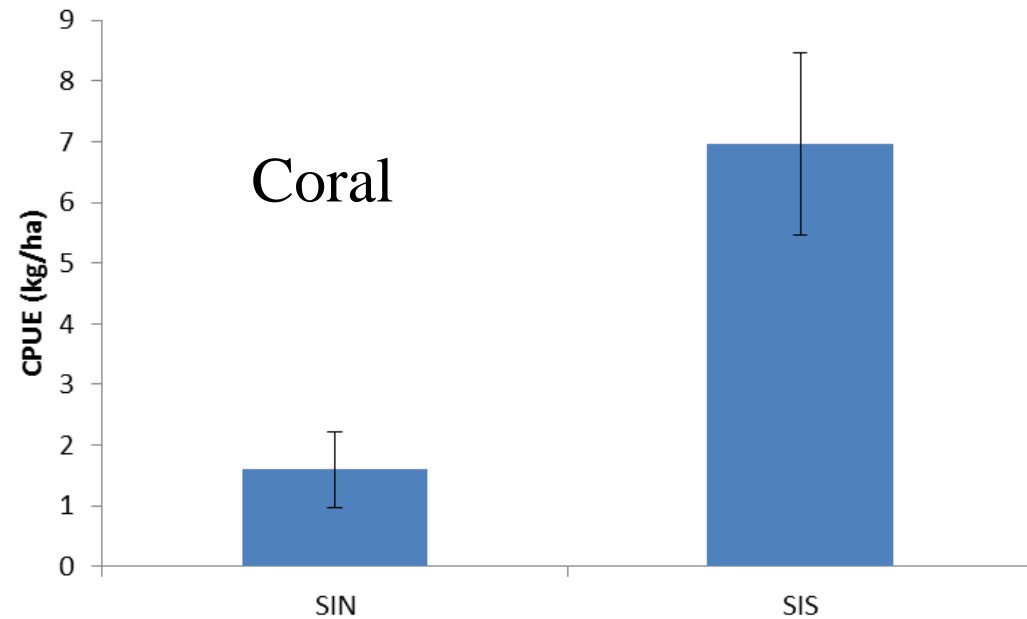
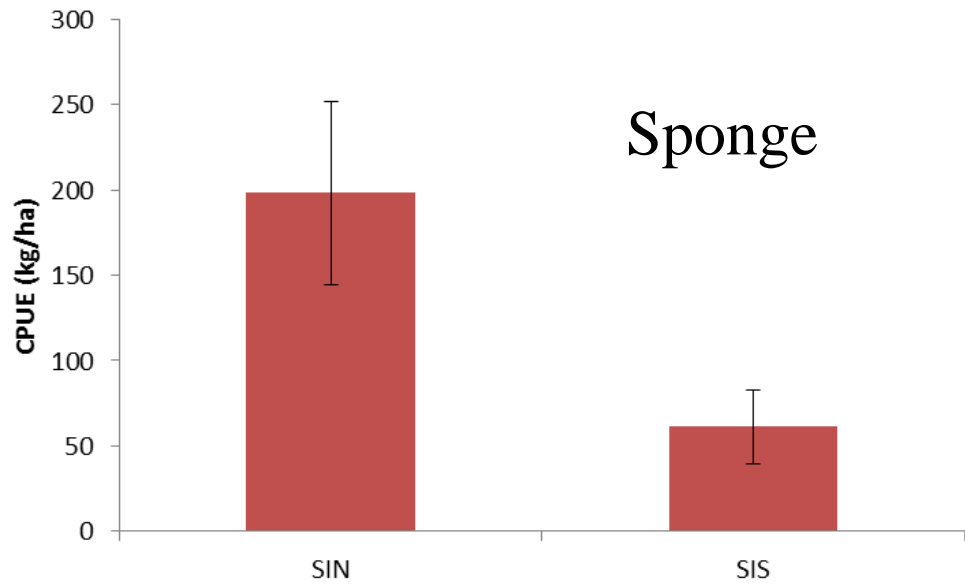
L-W residuals



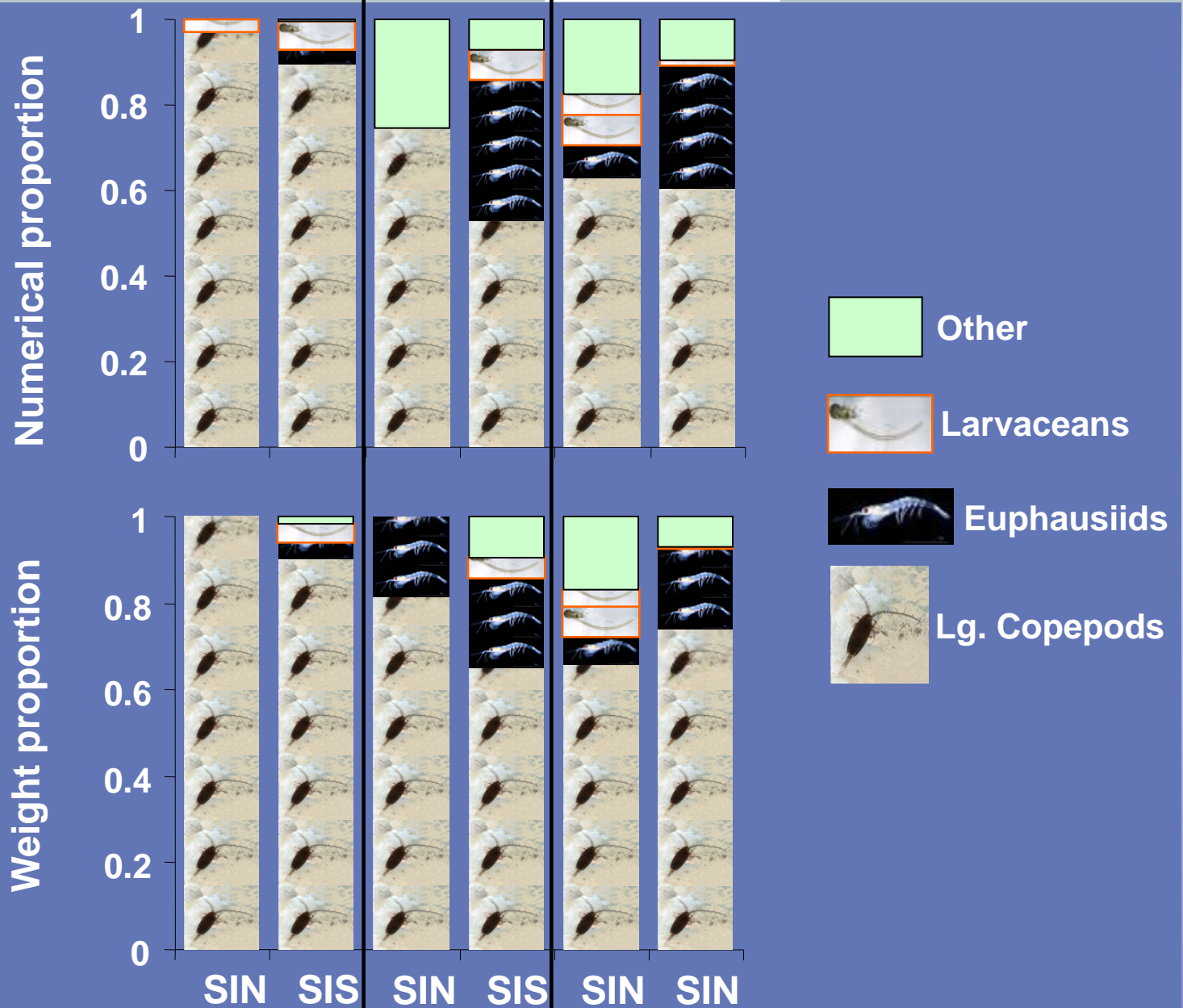
Juvenile POP growth



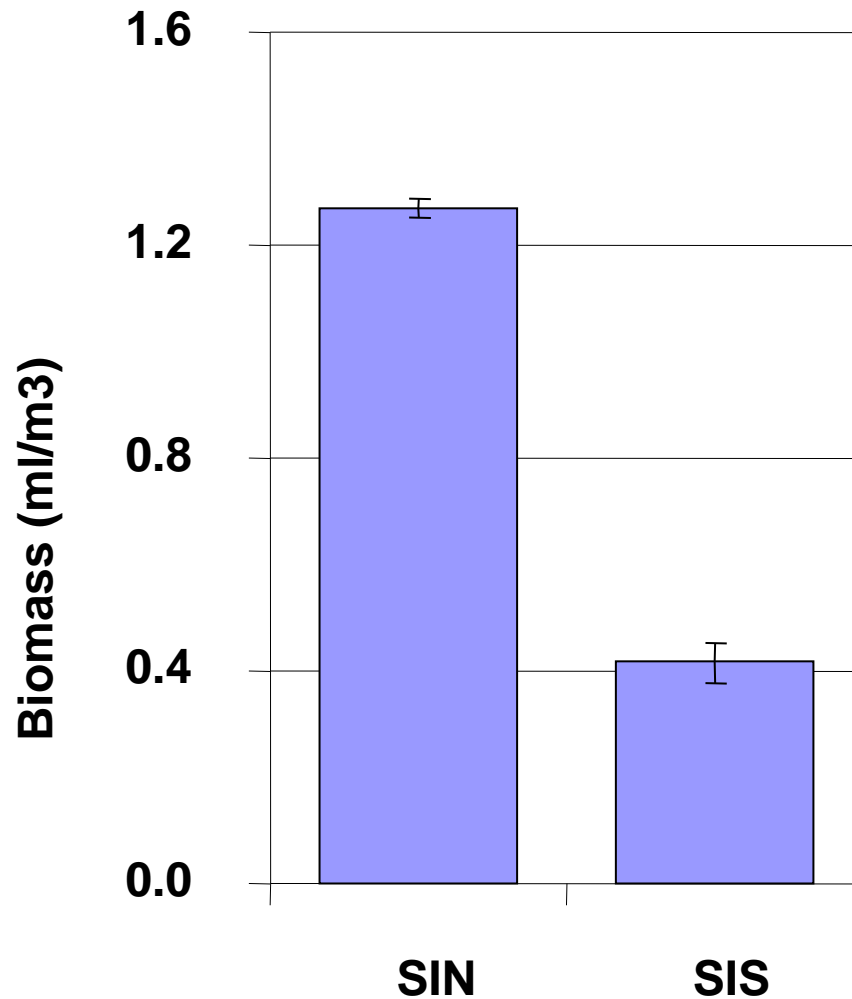
Invertebrate Biomass



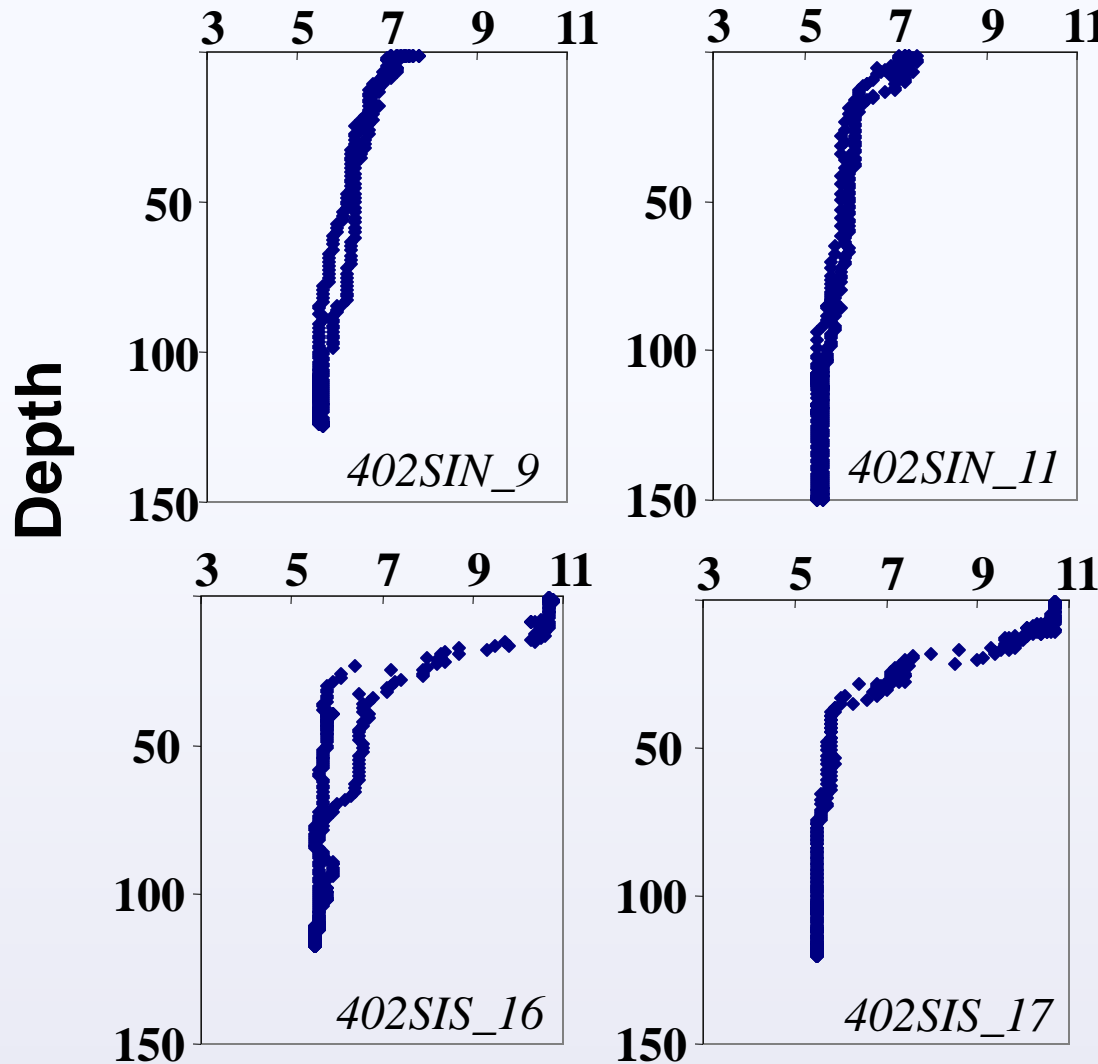
Diet



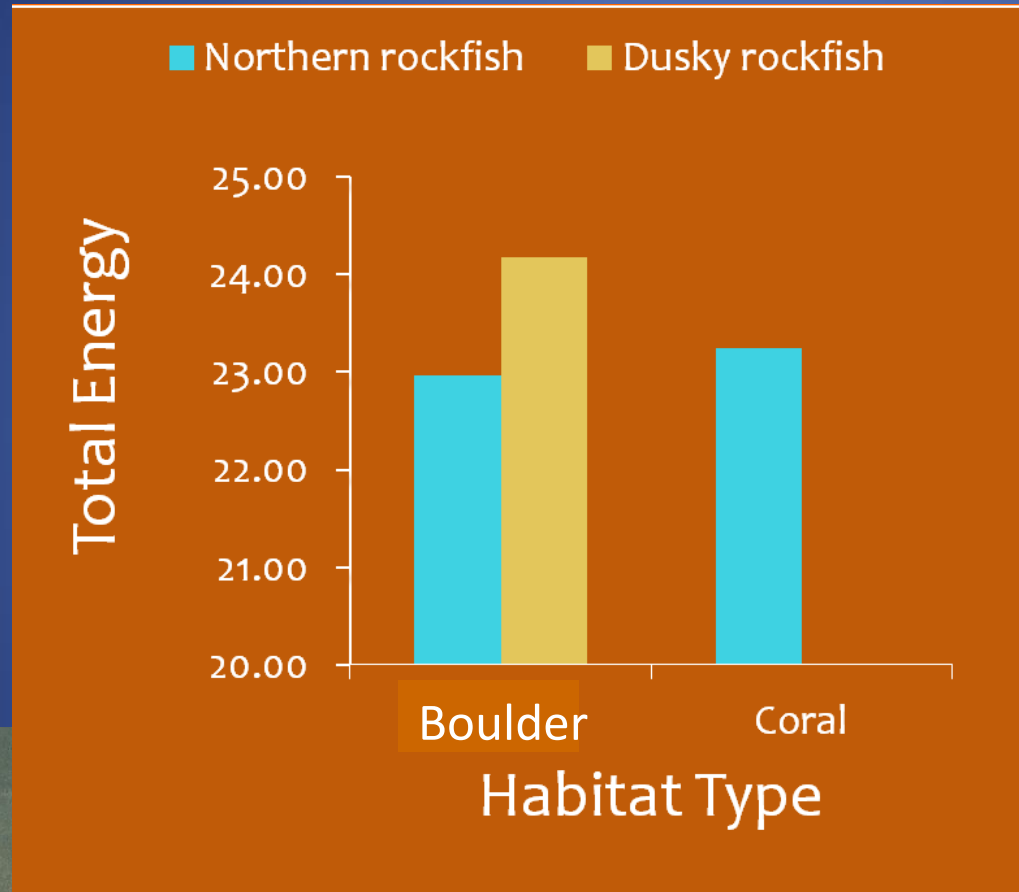
Zooplankton Biomass



Temperature



Adult rockfish – DSCRTP Alaska Study Central GOA

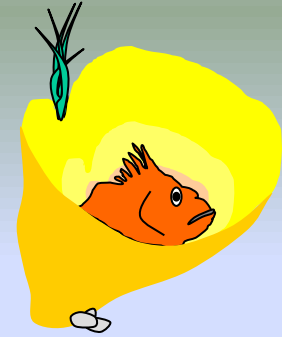


Also measuring

- Fecundity
- Growth potential



Does coral or sponge presence increase rockfish growth or condition?



Maybe:

- Condition was higher where sponge density was higher for juveniles
- Growth didn't vary significantly
 - Higher zooplankton biomass = higher condition
 - Higher temperature = higher condition

Local feeding condition dominates

Overall questions:

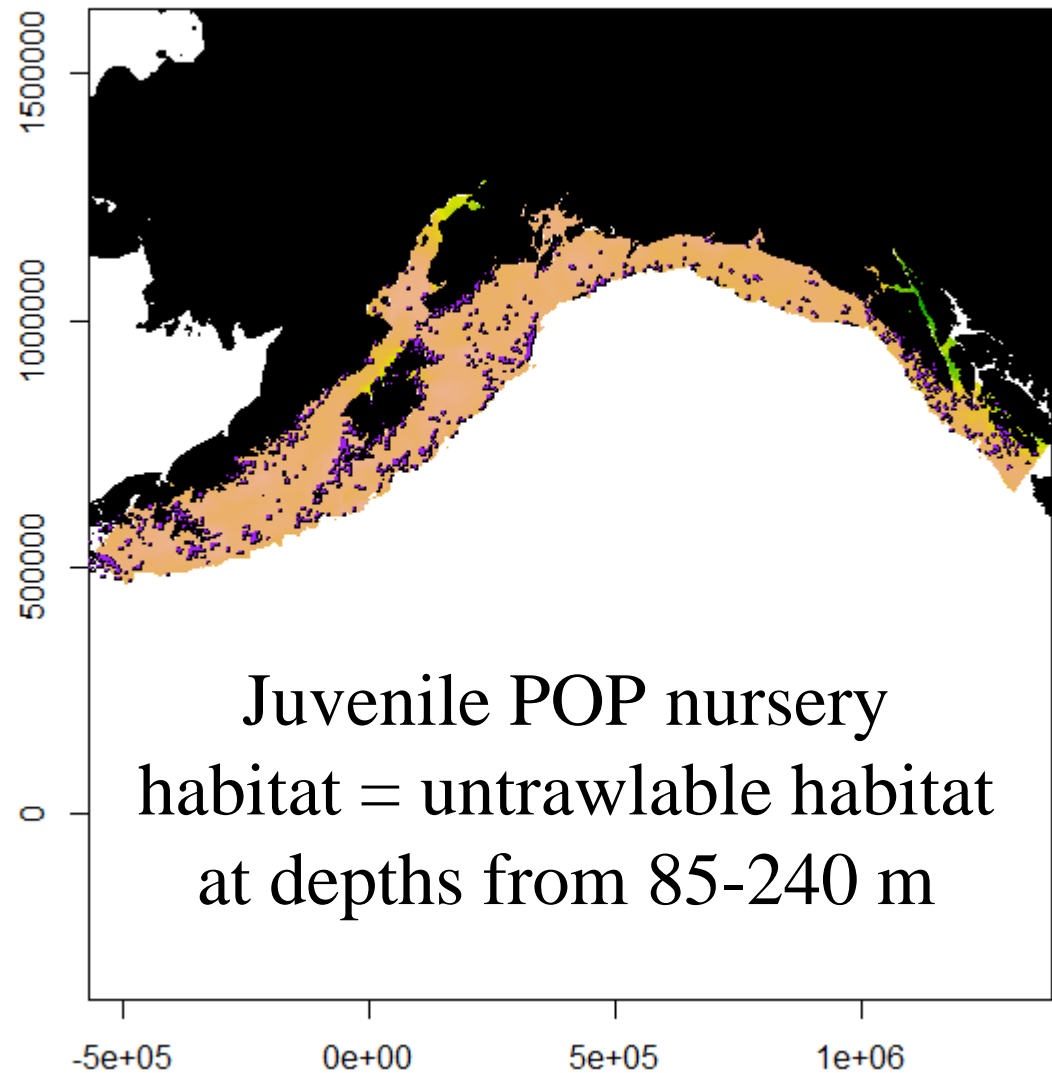
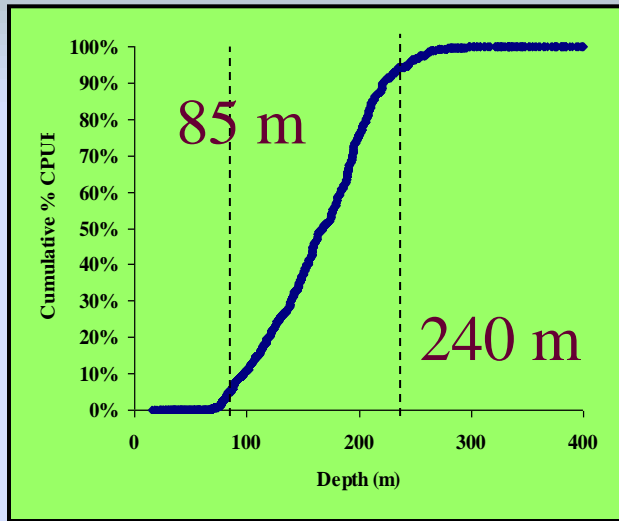
Are there more rockfish where coral and sponge are present?

Does coral or sponge presence increase rockfish growth or condition?

How much fishery production do we lose with every kg of invertebrates removed?



Depth distribution

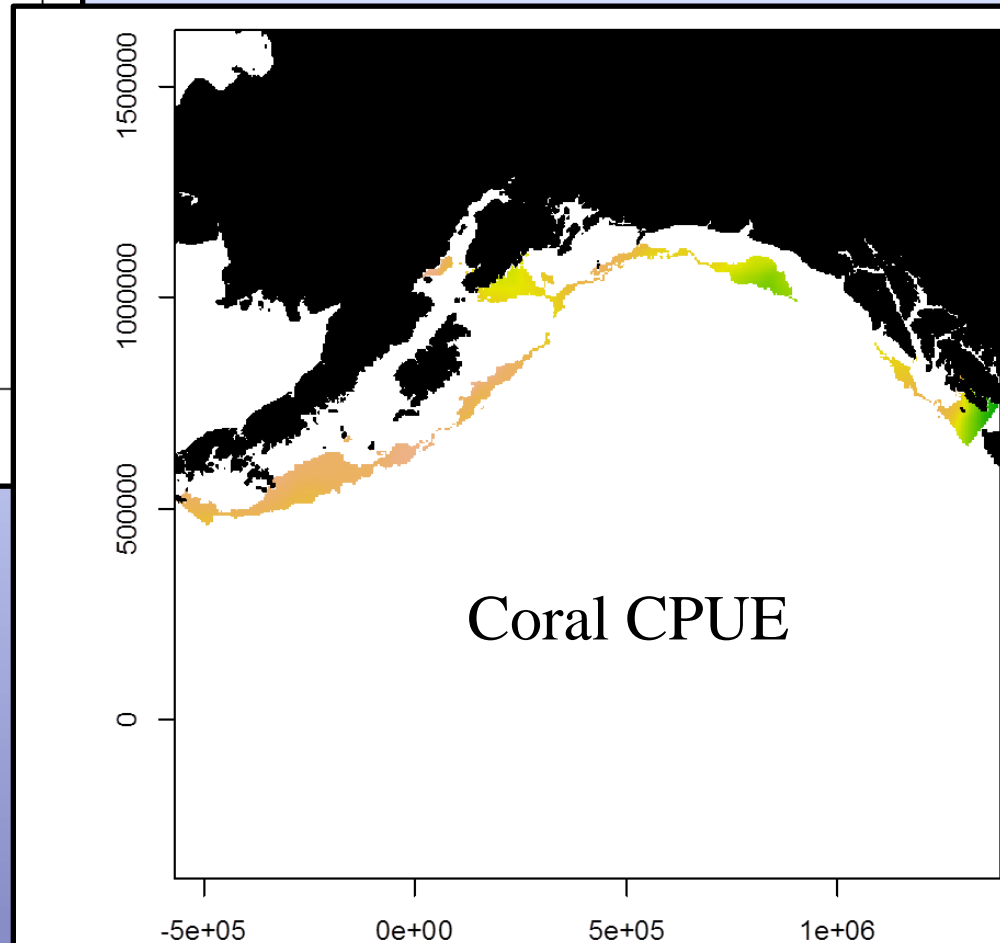
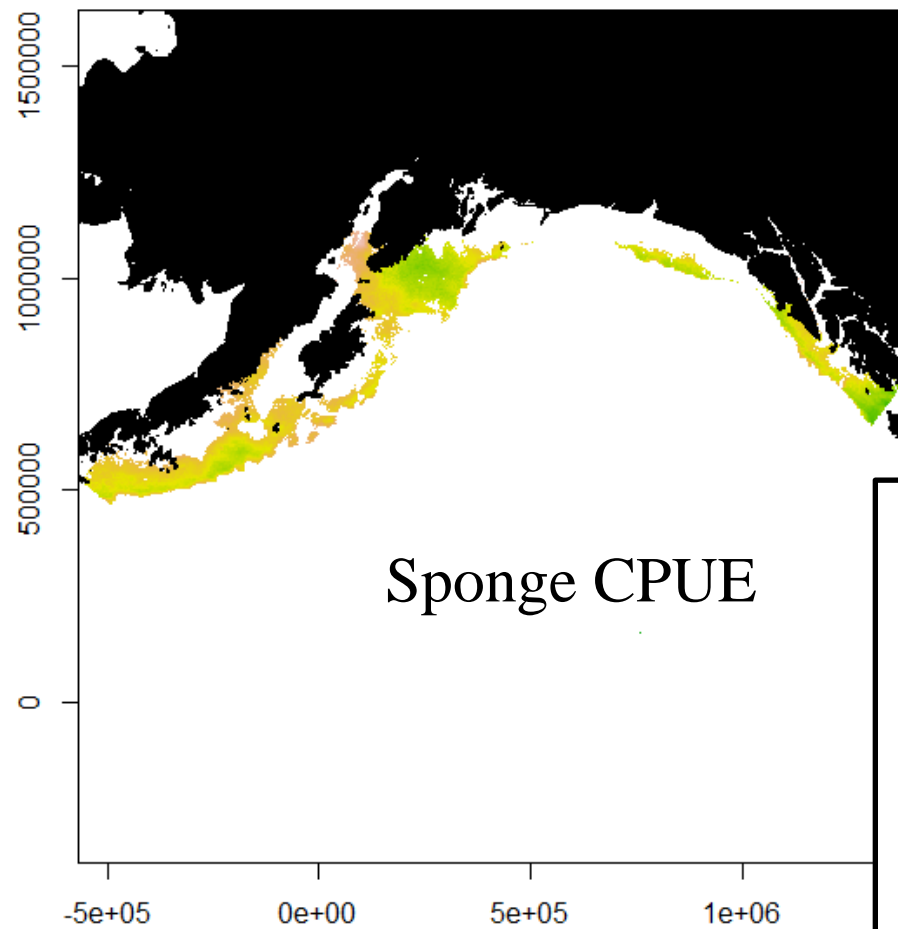


Total nursery area = 20,334 km²

Mean recruitment = 52,235,000

Age 2 Recruits = 257/ha

DSCRTP Modeling Studies



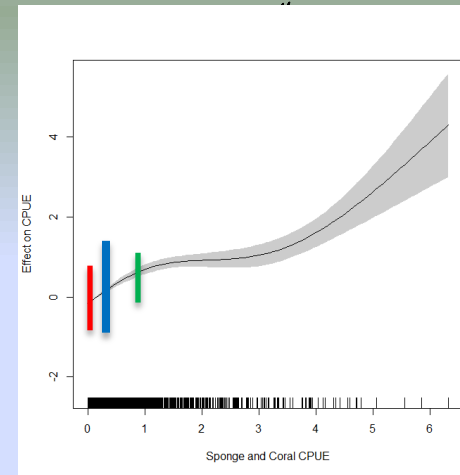
Combined nursery average
= 1.08 kg/ha

How much fishery production for a kg of coral and sponge?

POP recruits = roughly 257/ha
- 1.08 kg sponge and coral/ha

- Remove all the sponge and coral
- 233/ha (roughly 8% drop)

- Increase sponge and coral by 1 kg/ha
- 521/ha (roughly 100% increase)



Summary:

1) Are there more rockfish where coral and sponge are present?

Yes, but juveniles and adults use the habitat differently as do different species

2) Does coral or sponge presence increase rockfish growth or condition?

No for growth, possibly for condition, but feeding conditions (local) seem more important

3) How much fishery production do we lose with every kg of invertebrates removed?

Lost 24 recruits/ha by removal all

Gained 264 recruits/ha by adding 1 kg

Probably close to having the answer to #1

Probably soon have the answer to #2

Far away from seriously answering #3



Collaborators



- Video and Acoustics
- Gary McMurrin – RACE RSST
- Scott McEntire - MACE
- Kresimir Williams – MACE
- Bill Flerx - RSST
- Bob Lauth – RACE GF
- Patrick Ressler – MACE
- Taina Honkalehto – MACE
- Mark Zimmermann – RACE GF
- Chris Wilson – MACE
- Tom Weber – UNH
- Bob Stone – ABL
- John Olson - AKR

- **Funding Sources**

- North Pacific Research Board
- NMFS Essential Fish Habitat Program
- NMFS Industry Cooperative Program
- AFSC - Resource Assessment and Conservation Engineering Division
- DSCRTP

- POP Diet & Energetics
 - Ron Heintz - ABL
 - Kerim Aydin - REFM
 - Mary Auburn-Cook – Inverte Inc
 - Dave Beauchamp – UW SAFS
 - Jon Hill
 - Sonia Batten
-
- Data and Analysis
 - Michael Martin – RACE GF
 - Mark Wilkins – RACE GF
 - F/V *Gladiator*,
 - F/V *Ocean Explorer*
 - F/V *Vesteraalen*
 - F/V *Epic Explorer*
 - R/V *Oscar Dyson*
 - GOA and AI Survey Scientists